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USSR: Computers

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SCIENCE & TECHNOLOGY

USSR: COMPUTERS

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THEORY OF COMPUTATIONS

MACHINE ENGINEERING IN COMPUTER AGE DISCUSSED

Moscow IZOBRETATEL I RATSIONALIZATOR in Russian No 12, 1986 pp 16-17, 25

[Article by K. V. Frolov, academician and Vice-President of the USSR Academy of Sciences and V. I. Babitskiy, Doctor of Technical Sciences and senior scientific worker at the USSR Academy of Sciences Institute of Mechanical Engineering imeni A. A. Blagonravov: "Machinery and the Art of Construction in the Computer Age"]

[Text] The intensity with which man gets involved in production and energy matters is impressive. But this is only the quantitative development since wind, water and steam began to be tamed in time immemorial. Now massive amounts of new materials are being created, but this was really just the transition from the stone age to the bronze and iron age!

There is a distinctiveness at the present stage of the scientific and technical revolution with the appearance of a fundamentally new weapon for labor, the computer, which is becoming a certain participant in technological progress and a component part in many technical mechanisms. Similar to a developing human embryo, at some stage in its "ontogenesis" (development) equipment has acquired its own nervous system and brain. It will define the optimum moment for a motor's gas distribution and ignition by considering all the influencing factors built in the micro-computer; a comfortable automotive suspension will "prudently" adjust its own fluid, damping level and road clearance to the road profile; a telescope mirror will constantly readjust its own curvature by considering the observation conditions and deformation. All of this is realistic...

An it is not only production materials that are changing in an impressive fashion. Production itself is being altered. Computer and controller equipment are changing organizational principles that have been in effect for decades, if not centuries. In fact "universality" and "automation" have always been contradictory concepts. A skilled craftsman satisfied the most refined individual requirements of a capricious client at the price of the universality of his own skill. On the other hand, the automated production line generously turns out good quality and inexpensive goods, but they are depressingly indistinguishable. The scientific-technical revolution is trying to remove this contradiction by giving birth to flexible automated production that uses standard equipment with numerical control programmed by computer.

And no one is surprised, for example, by the fact that complexes of metal-cutting tools are rated for a wide range of components. It takes only minutes to transition to a new item with different sizes and configurations. Remember only very recently, in the early 50's, we had many people who wrote about automated automotive piston factories, the epitome of that stage of automation and the dream-factory. And then it took a major factory reorganization to make pistons for powerful tractor motors instead of for automobiles... We are now on the threshold of manufacturing that will allow us to produce a new product by simply changing a program.

This situation, one that is unprecedented in the history of machinery, the appearance of "inspired" machines, is creating new tasks for our very old and eternally young science, mechanics.

"A healthy body has a healthy mind!" The microprocessor "spirit" which links the machine and the computer is healthy and useful when the "body" is whole, and the machine itself and its construction have been inspired by a thorough understanding of the laws of mechanics and controls.

A modern machine must be as flexible as the computer that controls it. Only then will their union be fruitful. This is the reason for the search to increase the number of levels of freedom and the quality of articulation and to make kinematics more complex. The chain of mechanisms from an actuator to the end component is unavoidably increasing.

Can the shepherd, by cleverly managing the whip, have the tip of the whip move along an assigned trajectory? Hardly, for this would be very difficult and in many cases, basically impossible. The kinematic chain between the link that is the receiver of the motion (the end of the whip) and the link that is controlling the motion (the shepherd's hand that is holding the whip) is difficult to calculate because of its infinite number of levels of latitude, its flexibility distribution and its mass.

Machines with an "inflexible" program have an input shaft that turns steadily, and the characteristic of the assigned motion and its precision have been determined directly by the machine's output through a camshaft or other such mechanism which also designated the program. Now the interaction contact zone for a cam's work surface and for a spinning caster has been extended into a long chain. To keep the equipment as precise as before, we have to learn to create these chains so that they do not have gaps and pliancy and so that their rigid and light links are able to withstand the fast, reversing, precise motion as ordered by the electronic commands.

Of course designers try to maximize kenetic simplifications in universal machines and the algorithms that control them. They put the motor near the output link, using so-called high-moment motors that do not require intermediaries such as reducers since these motors can overcome significant resistance in the wide range of speeds. Feedback sensors that monitor the shifting of the machine's operating elements in space are installed as close as possible to these elements to reduce the impact of errors from intermediate links in the kinematic chain... And yet we must pay a price for the cost of this universality of motion and that is both the machines and the dynamic processes that take place in them have become more complicated. The load intensity and mechanical stress in construction are increasing, deformation and dynamic errors are increased, and there is a strong sensitivity to wear and articulations, bushings and links.

Our machines are not accustomed to different types of motion and are stressed by them. When a program has been changed the stress pattern on its assemblies and subassemblies is altered. It was not difficult to eliminate the errors that appeared in fixed machines through adjustment because the motion of the output link was the same, assigned once and for all. Image that you are going to work in a bus along your well-known, usual road with which you have been as intimately associated for many years as you have with your apartment. You know where the driver has to apply his brakes at the traffic light and when the bus, after grunting, crosses pits and bumps with a moan and squashes you against your neighbor at every turn. You are prepared ahead of time for these peculiarities on the road and you are able to respond to their studied, familiar motions and the trip does not inhibit your ability to read the newspaper as you travel along the road.

But it is another thing to take a bus trip when you are on official business in an unfamiliar town. Then there is no chance to read the newspaper because you have to be constantly on your guard and on alert. And this is how it has been when robots that have been carefully and successfully programmed to accomplish a specific movement are then catastrophically transitioned to another program. Positioning errors increase for several sequences and as the saying goes, they are very apparent. The mechanics of such robots cannot pass the test of universality and the "unfamiliar road" has shattered them.

We have been forced to complicate kinematics (and therefore dynamics) on the path toward universality to make different types of movements possible. But this complication reduces productivity and accuracy. There is a contradiction, a barrier, that never before appeared in the history of equipment and one that is calling for additional theoretical research and the need for inventions to be developed.

This is how it was at the dawn of automation when it was discovered that the increased sensitivity of centrifugal sensors lead to a loss in stability, an decrease in revolution uniformity and unallowable variations in angular speed instead of the expected increased accuracy in maintaining the assigned steam engine revolutions. An outstanding academic and engineer, I. A. Vyshnegradskiy understood the problem and solved it in a surprisingly easy manner in the 1870's. He put supplemental damping in the regulator. Later the appearance of the loss of stability in controlling automobile wheels and the wheels on an airplane's undercarriage, i.e., shimmies, and also the flutter, the oscillation in the surface of airplanes from head winds, were serious barriers in the development of ground and air transportation...

It takes more than solving the problem of universality by eliminating a barrier that is caused by computerization to coordinate the operations of a computer and a machine. There are also other, very specific tasks that come up. Dynamic and algorithmic compatibility are among the most important of them, for example. The speeds of modern machines are great and controlling algorithms are complicated, and at times there is no way to ignore the times for controlling motors to process control signals, for in that time the operating instrument can send something where it should not go. Therefore it is necessary to coordinate the dynamics of the mechanical and electrical parts in an "animated" machine. On the one hand the extensive logical possibilities for having a computer control movements open up attractive perspectives for creating original algorithms for tracking, training and adaptation. These algorithms are certainly impacting on the design of machine appearance. Computerization could revitalize the non-linear method of control, relay and impulse and possibly, and thanks to that, actuators could be simplified. "Electronic kinematics" which uses programming instead of mechanical transmissions to support the synchronized, coordinated work of several actuator mechanisms in machines will certainly play a special role in the future. And the computer itself can help if it coopts drive interfacing. For example, the force of inertia that is formed during movement about one coordinate will be used to discharge mechanisms on another coordinate.

One can see a similar situation in the history of equipment. To improve electro-mechanic devices, it was necessary to create a new technical discipline, electromechanics. Mechanical and information and computer processes are closely interconnected in contemporary automated systems. Controlling electronic devices is an integral part of the overall design of a machine. A symbol of this already undeniable unity is the fact that people are using a new term, mechanotronics. Mechanics is resolving the key tasks in this new scientific discipline and its laws are dictating the content of algorithms. In the end the goal is always to create power systems at the required amount, the proper time and at the necessary locations!

The long-awaited enlightenment of one theorist or one windfall from a genius inventor for a situation that fits all others will not eliminate the contradiction or solve all problems that mechanics has had during the scientific-technical revolution. What is needed is progress on a wide front. The central figure in this progress is the designer, the plenipotentiary of mechanics in the engineering world. The time has come to return to this profession the romantic halo that once clearly and suitably shined, but that has now been almost lost. The general distribution of information and computer technology illuminated the real creative aspects of man's activity, those which do not lend themselves to algorithms. The designer initiates the creative beginning in mechanical engineering. But alas, there are no regular, all-encompassing rules that will guarantee that you can design a good machine, a masterpiece. But now there is one rule -- the harmonious complex of mechanical and electronic nodes, streams of energy, information and matter must not be taken apart, just as it is impossible to separate the muscle system from the nervous, circulatory and lymphatic systems. When designing a machine, one must feel this complex and listen to it as a composer listens to a symphony that is being born. The process of creating something new in equipment is close to a poet giving birth to a new line of poetry, to a composer's anticipation of a melody. A designer painfully seeks the one solution that satisfies the objective conditions and the internal feeling of correctness. When it comes, it is impossible to hold back the "Eureka!", as if the solution already existed, such as in a chess study, and one only had to look for it.

The famous Soviet artist Petr Miturich was not an engineer but he was drawn to the design of flexible, multi-unit transport vehicles, the "volnokics" as he called them. Professional designers find few defects in them and all agree that P. Miturich's poetic interpretation of the birth of a new machine is true in many respects. "I spent some time with our 'volnoviks' or to be more exact, with their spirits and I reached deeper and deeper into their character and the capabilities of their development. It was as if they already lived in my head and I only had to observe them in my free time... It is these as yet sterile spirits in which energy plays and seeks its own material embodiment. The feeling of a game of power in as yet undefined forms leads to the clever regularities needed for designing. There is something charmingly simple and free, as in dance or something from music or art..." (Miturich, M. P., "The Volnoviki of Petr Miturich", Technicheskaya Estetika Publishing House, No 10, 1985).

The creation of something new requires intuition and knowledge that are specific for each type of activity. A designer and creator of today's new technology must first know the dynamics of mechanical control systems, for it is these control systems that bring together and hold in check the many elements, assemblies, processes, and materials that make up contemporary machinery. When the dynamics are correctly seen and understood, the designer can adjust and fit them to one another and use them to most effectively support the basic characteristics of the machine, to include speed of operation, precision, economy, and reliability. It is the dynamics that creates the usefulness that lies at the depths of the machine's entirety, just as the integrity and harmony of an azure lancet Gothic cathedral are created by statics, the science of the equilibrium of forces, that is known by the architect. Today a thorough understanding of the dynamic processes that take place in a machine have become an vital necessity, for an error in dynamics will cause the system to self-destruct.

The art of the designer has always been to optimize and maximize the proportionality of the elements. Even using the improved mathematical equipment and the total power of computer technology, we are not able to re-create the unique violins of the old masters because we have lost the secret of the tonal dynamic properties of bow instruments and have unlearned how to optimally construct this complex mechanical system. The human hand has developed along with his brain for hundreds of thousands of years and has reached the highest level of improvement, but it still has only as many joints, tendons and muscles as in its "prototype," the simian's paw. The distinction is in the subtleties which also create a striking, useful effect. The lengths are proportional, the volumes are harmoniously combined and the powers of the muscle-drivers have been effectively selected... We must learn to construct machines that work with computers as faultlessly as nature was able to create the human hand and its controlling brain.

Can you imagine a student-composer who, instead of presenting his dissertation, gives the examination board one of Tchaikovskiy's symphonies after only altering the sequence of its elements for propriety' sake? Such things actually happen in engineering VUZ's [institutions of higher education]. And as in any creative vocation, the profession of mechanical designers and machine creators demands clear abilities, basic preparations and total selflessness.

The concept that the engineering profession is massive and open to anyone is terribly erroneous. The pursuit of "per capita" numbers of technical specialists has led to a catastrophic devaluation of this previously honored rank and to an unallowable reduction in the requirements for those leaving school and those entering technical VUZ's. In many cases having individuals actively and independently comprehend knowledge and develop professional skills through actually participating in developing original scientific and technical ideas under the leadership of experienced teachers is replaced by the formal compulsory mastery of a uniform collection of, at time, rather superficial information. How do we move from extensive to intensive trends in training engineering cadres? Would it be possible to borrow some organizational parts from the training experience in teaching musicians, actors, and artists such as the system of "classes" of artists, reliance on the individual development of technical skills, participation in competition... Who does not remember in this regard the excellent "class" of Professor N. Ye. Zhykovskiy who for many years defined the development of domestic aviation!

It is mandatory that we return the primary concept to the graduate work of students in the engineering specialties. Dissertational work must become a demonstration of the individual creative capabilities of the graduate, his ability to independently apply the entirety of the knowledge that he received at the VUZ and his ability to find organizational solutions. Work in these areas can begin in the beginning stages of the student's professional training.

The training of design engineers and those developing automated machinery and automated complexes is causing extreme anxiety. Unfortunately there are times when courses in machine dynamics and their basic foundations, the theory of oscillation, that are to be presented during the training for specialists in this area are not only not basic courses, but are not presented at all. University courses in these sciences are not oriented toward engineer. The primary engineering specialty "Dynamics and Machine Durability" that is for designers inculcates the skills of testing the calculations and reliability of already existing constructions, but does not provide enough information about designing or controlling machines. The training of people who are already experts in automated systems does not involve the primary mechanical disciplines such as oscillation theory, the mechanic of solids, theoretical mechanics, and practical machine design.

The constantly increasing role of the engineer is a natural part of technical progress. Therefore the development of the fundamental VUZ disciplines that are associated with the problems of synthesizing automated machines and systems and are connected with dynamics, control and permanence are critical. We are convinced that we should teach only those things that are difficult to master individually -- the fundamental sciences and the skills in applying them. And we should teach them only to those who have a clear ability in this area.

Equipment is developing rapidly and one must continue to study throughout one's life. But there are many aspects of the business qualities of an engineer that are defined by how this process began during the early student days and when the primary knowledge was solidified. It would be helpful for each specialist to hang his diploma at his work place with his evaluations as is done in several countries. One must earn his professional reputation from his early days.

Miscalculations that are associated with training design engineers can have serious negative social consequences. For example, a special commission of highly competent academicians has been established in the U.S. to research the contemporary problems before engineers and to develop recommendations to resolve these problems on a socio-governmental scale. There is an alarming fear that there will be a shortage of engineers because of young people reorienting themselves to more "fashionable" electronic professions. And we have also noted a similar trend in education. We must correct this disproportion. Talented, highly qualified cadres who have mastered the methods of modern science and the art of designing can combine mechanics and computers and they can display them only when designers enjoy very high prestige in society.

12511
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BLACK MARKET FOR COMPUTER GAMES SOFTWARE

Moscow KOMSOMOLSKAYA PRAVDA in Russian 13 Mar 87 p 2

[Text of article entitled "Computer With an Accent: Why Are They Going to the Black Market for Personal Computer Software and Not to Stores?" under the "We Bring Up Problems" Rubric, by S. Kozyrev and S. Sokolov]

[TEXT] Alert! Ready number one. A reusable ship has taken off from a rocket base in space. The task of the crew is to make a retaliatory strike on the strategic centers of the Russians. It is necessary to fend off an attack of fighter-interceptors, break through a wall of flames and make it to the targets.

Here is a game like that. It is loaded into the personal computer of our student friend. The program is called "Raid on Moscow." And the student does not explain to us very convincingly that it is only the thought skills, testing of knowledge and reaction speed that interest him in this game: you barely yawn and you are already knocked out by the antiaircraft defenses, and you can't even eject. He inputs false data into the computer, and the rockets miss their targets... But he pays no attention to everything else in this game - politics or otherwise. You can find yourself in the shoes of the invincible Rambo. He too does not enjoy being in battles and skirmishes at every second. If you want sharp sensations, give the roulette wheel a spin. If you want to rewrite history anew, "Battle of 1917" would come to your service. If you wish to control the destinies of nations, play around with the third world war. Everyone likes and everyone has accepted these masterfully created, intelligent and intellectually developing game programs. Except in each one it is unexpected, like a piano in a shrubbery, that one sees "politics" with a certain ideological stuffing.

Why are these programs popular? Well, because there are no others. And it is not possible to forbid their use, as it will be useless to do that until the call to compulsory computer education is completed, not with the creation of a regular demonstration school with a type of computer on the tables, but with what needs to be done.

We recently attempted to acquire a Soviet personal computer. It is true, our searches for the "BK-0010" were not crowned with success. The managers of the "Elektronika" stores invariably answered "there aren't any right now. They appear here very rarely." On the other hand, in a commission store [second-hand store] we were even faced with choosing from a large selection. But getting the computer is only half of the matter. A computer without programs is just like a tape recorder without cassettes.

What is to be done? Again we turn to the "Elektronika" store. Alas, there is no software for sale, and there simply never has been.

What then is to be done? It should be easier to get a computer. And since no one was about to suggest anything, we decided to ask ourselves. We telephone the Ministry of Higher Education. We find out that questions of software for "personal-shchikovs" are handled by the Scientific Research Computer Center of Moscow State University.

"Unfortunately, we can help neither 'BK' owners nor owners of imported machines," says the senior engineer of the interdepartmental laboratory for hardware and systems Nadezhda Aleksandrovna Vlasenko.

We dial the number of the Ministry of Education of the USSR. The senior methodologist of the department of program-methodology Irina Petrovna Khorosheva had an even less optimistic outlook. In the meantime, the Minpros [Ministry of Education] distributes from a centralized location only one package of school programs for the "Yamakha." The questions of distribution of the programs have not been resolved. Representatives of the republics must rewrite programs independently.

And so, our last chance is the Ministry of the Radio Industry [Minradioprom]. Without a doubt, professionals develop software here. And in fact, Viktor Kirillovich Nadenenko, chief engineer of one of the Scientific Research Institutes, weightily said "We work on the basic software for school computers. We recently sent several new programs to the commission."

Finally. We hurry to Zelenograd, to High School No. 719, known throughout the country for its computer class.

"What and about which personal computer programs are you referring to?" asked the school principal Lyubov Aleksandrovna Filimonova in surprise, and told us that, of the two hundred programs they had, about sixty were written by the teachers and students themselves, about forty were obtained from other Zelenograd schools, and the remaining programs were from the students at MIEM [Moscow Institute of Electronic Machine-Building].

And how do the schools get along which do not have an institute such as this one under their noses? How do people such as we get along? Do we search on the "black market"?

could get anything. And he asked us what we were looking for.

"Programs?" smiled the speculator sourly. "Those show up very rarely."

But it is true he remembered the price anyway. It costs from 80 to 200 rubles to buy a package of ten programs from a speculator.

We nevertheless went to Vasiliy Antonovich. Our friend the "sinklerist" Aleksey Vedeneev, a genuine programmer by profession, looked over the "wish list" and noted that one of the subscribers had persistently offered computer software in several issues of a newspaper. And that person was Vasiliy Antonovich. Of course, he does not write the programs himself, although he has learned how to distribute and sell them. But he calls this activity simply a hobby. Vasiliy Antonovich is ready to exchange programs with such "sinklerists" as Lyosha, but he has nothing against doing business with newcomers such as we. "Five rubles apiece" was the price he named and he offered us a list of 227 programs. Among them were programs we were already familiar with...

But, in order for there to be no such intriguers, the fellows suggest the creation of a common center for the exchange of programs, an original place to rent them, but it would be free. And this is not just talk. The members of the Moscow club "Interface" and the International Computer Club, begun recently near the Czechoslovak embassy, have already taken the first steps toward organizing such a center.

Another matter concerns which programs we would receive. Vasiliy Antonovich quite unintentionally gathered such a collection. He just diligently acquired what comes to us from abroad. We should note that there is not one domestic program in his catalog. There are almost none even among the "sinklerists" we know. Why?

In fact, only one student scientific-industrial division of MFTI [Moscow Physical-Technical Institute] has created more than thirty educational and game programs in a short period of time which have met with approval by teachers. Finally, there are several hundred thousand programmers at work in our country, and they could create the necessary program bank for not only schoolchildren, but for everyone who is or will be using a personal computer. A regular-issue "personalka" [personal computer] has already been created for schools, the "Korvet," and we know how many thousands will be produced in the near future. But as before there is total confusion over the software.

When we gathered before some young Moscow programmers, we hoped to answer at least some of our questions.

Unfortunately, after several hours of conversation, the number of question marks only increased. But we did find the "black market." Although it does not operate continually in the same place, it is hardly inferior to any "flea market." And it is clear why it has appeared. But while it is difficult to buy a computer, yet still possible, software is not sold anywhere.

Writing a program is no small task, and no one can evaluate the work because no one can understand a thousand lines of FORTRAN, a computer language. But, more seriously, the lack of standards and legal norms have led to the fact that we have educated thousands of programmers, and yet we have Western software packages. Why? A program is the same as an artistic work, and it must bear the name of the author on its title page. Therefore, the lack of authors' rights and royalties on the programs has led, for example, to the fact that the same program can be bought for the most widely differing prices, and the author may not even suspect that such trade is taking place.

But the young Moscow programmers gathered for this meeting not to complain to each other again about their problems. The fellows came with suggestions. There are several dozen stores of algorithms and programs in this country, but not one of them is ready to take in a regular amateur computer hobbyist. But how can we do without such storehouses, to which one could come as if to a library? One could examine, select and take what interested him. Who would do this? The local young computer club that the fellows want to create. And what kind of programs will come to this storehouse? The best programmers in the country will create them. It is only necessary that someone take the iniative in getting it started, by, for example, organizing a competition to develop the programs needed now. It would award prizes to the winners. And the best programs would find themselves in the library and on the desks of schoolchildren. So, maybe, we will start with a competition.

But yesterday there was an announcement that read: "I am selling a personal computer BK-0010. New."

I call.

"Why am I selling it? Well, there is only one problem with it. First I waited in line for a year in the "Elektronika" store before I could buy it. But they just do not sell programs for it anywhere. So what do I need it for?" concluded with irritation Denis Komarov, a student at a Moscow tekhnikum.

13151
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WORK AT THE ELEKTRONMASH PLANT

Kiev RABOCHAYA GAZETA in Russian 12 Feb 87 p 2

[Text of article entitled "The Fate of the Chernovitskiy Computers" by V. Nazarchuk, correspondent for Rabochaya Gazeta]

[Text] The hands on the clock over the access way into the Chernovitskiy Production Association "Elektronmash" reached the "work" position, and the next work day of the five-year-plan began. The day was at the same time usual and unusual. On one hand, it was like an ordinary day, and on the other hand it was the end of the month. Everyone well knows what that is. Everyone to work! However much Z.N. Mikhailetskiy, general director of the association, tries, he cannot change the time on the clock. Therefore he must begin the morning of his work day not with the solution to the long-term scientific-technical problems scheduled in advance, but by making his mouth sore explicating who has not done enough of what, and how to "pull off" completion of the plan.

In a few minutes he will call an operations meeting, where this time they will "anguish over" these problems, and develop tactics for getting out of this complex position. Moving ahead, we note that for the time being Mikhailetskiy will manage to do so. In any case, the association successfully fulfills not only the plans for factory production, but also carries out the required deliveries. At what price this is achieved only the director and his closest associates know.

These talks in the association have been popular for a long time. The director gave the first one when the small semiconductor elements plant was still switching over to computer production. It was a new, delicate and complex matter then. Specialists undertook the work cautiously. After the first failures some of them simply decided to leave the plant. At that time Z.N. Mikhailetskiy, who had just been named head of the SKTB [Special Design Engineering Bureau], assembled the most steadfast and daring people and spoke this folk wisdom. And it immediately instilled a certain confidence in them.

First they mastered production of specialized functional modules for the "Mir" and "Dnepr" computers, then they began manufacturing boards for printer assemblies and power supplies. From year to year the components became more complex and the number of qualified workers and engineers grew. The logic for development of the enterprise lead to the production in 1975 of the plant's first finished product - a most simple keyboard computer.

But in order for the computer to work, it is necessary to add a whole set of peripheral devices, with whose help the machine could act on the control object. Mikhailetskiy understood that he could not accomplish this on enthusiasm alone. It was necessary to have a good basic design, and, most importantly, people who could advance the design theory. He searched them out everywhere - both in the factory and outside it. For example, O.T. Vavrik, today the chief engineer, who replaced Mikhailetskiy as head of the SKTB, worked a great deal in various engineering capacities in the enterprise. V.V. Krasovskiy, now the leader of one of the main departments of the SKTB did this also. But F.E. Korkmazskiy was taken from the Leningrad Institute of Precision Mechanics and Optics. And P.N. Grinchuk was taken from one of the enterprises in Alma-Ata.

In general, people were selected who were skillful, and in fact obsessed with computer technology, dreaming of higher universal achievements. Dreaming, as they say, is not sinful. However, the actual requirements of production quickly brought them back to earth.

"For the time being we will leave the machine itself alone," said Z.N. Mikhailetskiy, "We must now produce a control instrument. Being without a control instrument is like being without hands."

The engineers handled the task successfully. In a short time they created an entire series of peripheral devices and they raised the "qualifications" of the computer. Now, as they say, the computer "has left." The Chernovitskiy machine was readily utilized in automated control systems for technological processes in enterprises for machine-tool construction, energy production, including atomic energy, in metallurgy, chemistry and petrochemical science, in shipping, and other fields.

"But even though it satisfied the consumers, we understood that this was still the wrong technology for the times," explains V.N. Kushch, head of the SKTB VT [Special Design Engineering Bureau of Computer Technology], "In general it was a set of hardware devices, but it was not a system. The task consisted of consolidating the computer and the peripheral devices, and making it more universal and portable."

The lead group was headed by A.M. Sharafan, one of the engineers. He was not chosen accidentally. Sharafan had perhaps made the most substantial contribution to what had been produced at that time.

He cannot help but write down the phrase "the attempts were crowned with success." This is only partially true. The terminal that the Chernovitskiy engineers had created, connecting with the TVSO-1, made a complex journey before reaching the workshops. There were successes and there were mistakes. But it eventually became the highest achievement not only in the association, but in the entire branch of industry as well. In one product they succeeded in synthesizing practically everything they had made before, creating an integrated-design control computer.

The terminal immediately came to be in high demand in many branches of the economy. A waiting list for it developed for several years in advance. But the customers demanded somewhat bigger terminals, as well as certain modifications for the tasks they ordered them for. This necessitated large expenditures for producing engineering and operations documentation and for preparatory work.

Thus, the convenience given the customers by the computer turned into great inconveniences for the Elektronmash engineers. The case was such that the engineers, and particularly the SKTB specialists, had to consider increasing the productivity of their work.

"To a large extent we had assumed there would be such an effect," says A.M. Sharafan, "we therefore knew, even in the process of working on the terminal, that it would be necessary to create a computer aided design system (CAD), which would free the specialists so they could resolve more long-range problems.

It is easy to say the word "create." But the first question is "from what?" CAD systems did not exist in that branch of the economy. It was necessary to produce one themselves. To do that they developed a special-purpose program in which not only the offices of the association, but also the Severodonetskiye Scientific Research Institute for Control Computers were coordinated. A CAD department was created, headed by A.M. Sharafan, so that gathering an additional staff of draftsmen was not necessary. After only a few months the system released its first documentation for the TVSO-1. This success is difficult to evaluate: one machine replaced the routine work of 50 people.

"Introduce yourself," said designer F.E. Korkmazskiy, and the machine instantly produced all the information about itself. Then Filipp Efimovich asked it several questions. And each time the computer answered concisely, without superfluous words.

"The computer understands human speech?"

"Of course," answered the designer with pride. "It is equipped with a voice signal analysis module, built in our SKTB.

Yes, today the VSAM (voice signal analysis module) is the pride of the Chernovitskiy engineers. Everyone who visits the enterprise becomes acquainted with it. It was actually the system of the USSR Ministry of Instrument Building, Automation Equipment and Control Systems that first taught the computer to "understand" human speech. Of course, for the time being the VSAM is no more than an original game, protected by a number of patents. But the future holds more long-term prospects for it.

Why is the module necessary?

"The fact is," explains V.V. Krasovskiy, head of the department for development of means for information display and memory devices, "the speed of the input of information and preparation of the data are the weak point of the computer. And our speech input device immediately allows us to increase the productivity of the machine compared to keyboard information input by a minimum of two times."

This makes the development particularly relevant. It raises the third-generation computers operating today a level higher. The State Interdepartmental Commission came to the conclusion that utilization of the VSAM is possible practically everywhere there is an automated control system. The USSR Ministry of Geology has demonstrated particular interest in the new device. They plan to utilize the module for rapid data processing of the results of geological survey work using a radio link. The information will be input into the computer by radio from hundreds of kilometers away. The geologists will receive the results of the analysis in the same way. The designers themselves place greater hope in the VSAM. The CAD systems they have equipped with VSAMs have increased productivity and free the operators' hands from the keyboard, eliminating even occasional mistakes in preparing documents. The module works with the TVSO-1 as well, which makes it even more reliable.

In a word, the advisability of using the voice signal analysis module cannot be doubted. But while the experimental model was being manufactured it was necessary to overcome stagnation, interdepartmental barriers and open distrust.

"In one institution," admits O.T. Vavrik, "they said to me 'Why have the Chernovitskiy engineers begun such a complicated task?' And even in the association itself puzzled voices were heard: 'we cannot even raise our heads up from these plans, and the devil knows what you are doing! We would be better off perfecting the serial production.'"

Of course, now that O.T. Vavrik has become the chief engineer, one cannot doubt that he will take the job to its logical conclusion - industrial production of VSAMs. But other problems will be resolved with time as well. After all, he is a designer. And who can see more clearly than he the previous era of computer technology and the directions in which it has developed. These directions, by the way, are today clearly defined. The gaze of the designers of the association is primarily turned toward the central part of the machine, the processor. Now, single-processor systems are being produced everywhere. This places them open to criticism. It is costly to remove the processor from the machine, as the whole system comes to a halt. Perfection of the system is proceeding along two paths: on one hand the reliability and productivity of the processor is being increased, and on the other hand two- and three-processor machines are being developed. This guarantees one hundred percent reliability of the computer itself.

As a whole, the efforts of the designers are directed at bringing all of the computer technology produced in the association up to world standards within this five-year-plan.

The creative potential of the specialists of the association allows one to hope that the most modern technology will be developed. The question is whether the association will be able to put it into production. As they say, you can't jump higher than your head. In order to manufacture modern computers, it is necessary to have a high degree of automation and precisely flowing rhythm in production. Today, "Electromash" cannot boast of having either one. A situation has developed in which one senses an acute shortage of productive floorspace. Workshops are so overloaded with equipment and finished output that even walking through them is difficult. In practically all factories general-purpose equipment is used. Almost half of it is utilized at 10 to 20% efficiency.

There is practically no substantial progress being made in the organization of production. As before, shop managers complain of poor capacity to produce finished products.

"We receive in the cooperative system thousands of designations of various finished products," says the head of shop No. 15 I.Ya. Kachko. "Imagine how precisely and rhythmically it would be necessary to work in order for them to arrive here on time. In practice, this does not happen."

A delayed delivery, unfortunately, leads to a disruption in the rhythm (50 percent of production is sent out in the third 10-day period), and, particularly damagingly, leads to low quality.

As a whole, it is true, there is certain progress being made in resolving the problem of quality: This is attested in advance by the state seal of quality on the computer-peripheral link, which has raised the share of higher category production, compared to the plan, by more than 10 percent. But this in now way indicates that the problem is already resolved.

Thus, for the electronic device manufacturers there is no alternative - reconstruction is necessary. And it is needed not so much for the technical rearmament of production as for the reorganization of the psychology of thought of the workers and engineers themselves.

"With today's attitude towards work it is difficult to speak of mastering the production of new generations of computers," considers general regulatory controller S.V. Tovstitskiy. "We often perform obviously hard labor, saving the situation."

No matter what perfected technology the SKTB creates, without Tovstitskiy it would be impossible to put it into production, inasmuch as he is a worker. And a worker of high qualifications. Graduating from the Dnepropetrovskiy Telemechanics and Automation Tekhnikum, Tovstitskiy has worked in shop No. 2 for seven years. Since he has been here, the terminals have been going directly to the consumers. He manages to send a quality machine from the factory on a reduced budget [tekhprogon]. Today, because this is necessary, he can be convinced with "objective reasons." But when after the reconstruction the regulatory controllers' positions are eliminated, it is doubtful that they will reach a compromise.

Of no small importance for Sergey and his wife Angelina Tovstitskaya, an OTK [expansion unknown] controller, is the question of how during the course of the reconstruction social problems will be resolved. And whether they will be working here or will find a more suitable enterprise in this field then depends on this. For four years they lived in a corner of a private apartment. Now, for the last three years, together with their son Dimka, they have been living in a dormitory. But such a mature specialist should have his own apartment. He is about 180th in line for one. It is difficult to say today when one will become available. In the meantime, the association is building living quarters, as they say, in minute quantities.

F.E. Korkmazskiy and his comrades also need the reconstruction. They very much want to move from the makeshift area where they now work to a laboratory more suitable for the creation of "intelligent" machines.

In general, the situation forces Z.N. Mikhailetskiy to put everything at stake for the sake of the reconstruction. He has been "pushing things along" for several years already. He has sufficiently haunted the higher departments. The question has seemingly been resolved. Money has been set aside. The work is slated to begin in 1988. But questions remain even after this decision. In the meanwhile the main emphasis lies exclusively on production. Unfortunately, the SKTB will not improve its conditions even after the reconstruction. The experimental base will be insufficiently developed. It is not likely that there will be fewer finished product suppliers. Much is unclear in the social development of the association. But perhaps the main problem is the contractor. Frankly, there are few hopes on the "Chernovitsstroy" trust. It will not succeed with today's volume of output. And if it spends millions more on the development of "Elektronmash"?

Thus, today a whole package of problems are accumulating, and they will perhaps be carried over into the next five-year-plan. And this is not counting the problems that will arise during the course of the reconstruction.

But in order to resolve these and many other problems, it is necessary, as was emphasized at the January Plenum of the TsK KPSS, to "act, act, and act once more - actively, boldly, creatively and competently!"

13151
CSO: 1863/279

SERIAL PRODUCTION OF TVK-1

Vilnius SOVETSKAYA LITVA in Russian 25 Feb 87 p 4

[Unattributed article: "Created, Introduced: Completing a Group of Computers"]

[Text] The output of more modern computer hardware for a new generation is projected this year at the Telshyayskiy plant for calculating machines.

One of the innovations is an industrial computer complex, TVK-1, which is designed for control and management by process nodes. They will find application in enterprises which turn out computer hardware. At the plant, their serial production has begun.

13093
CSO: 1863/216

COMPUTER GRAPHICS AND SCIENTIFIC RESEARCH AUTOMATION

Moscow PRIRODA in Russian No 2, Feb 87 pp 50-61

[Article by Viktor Lvovich Perchuk, doctor of engineering sciences, member of the Presidium of the Far Eastern Scientific Center of the AN SSSR [USSR Academy of Sciences], director of the Institute of Automation and Control Processes of the DVNTs AN SSSR [Far Eastern Scientific Center of the USSR Academy of Sciences], professor at Moscow Institute of Engineering Physics]

[Text] Let us first try to understand what the concept of "scientific research automation" means. For the overwhelming majority of researchers, it is primarily using computers to perform complex experiments and process the results of them. Such experiments involve acquisition and analysis of an enormous quantity of data characterizing the state of an object under investigation and the instrumentation. In the process, automated (with the participation of the experimenter) or fully automatic control of the experiment itself by using a computer is considered the highest level of automation. These directions of automation have been developed rather well. Modern hardware for conversion of information, communication between instruments and a computer, etc., meeting international standards, and specialized computers are produced in series for them.

But there is another type of experiment. In them, a researcher deals not with physical, chemical or biological objects, but with mathematical models of them. Usually, such experiments (they are called computer or machine experiments) are performed when experiments with the objects themselves are not possible for one reason or another or some properties of these objects can not be studied in them. Computer experiments, as a rule, are performed many times and allow obtaining new knowledge about the objects and processes under investigation or clarifying relationships established earlier in experiments with the objects themselves.

An example of research in which conventional experiments, to put it mildly, are extremely undesirable is the study of the global ecological consequences of human activity. For example, a real "experiment" to study a "nuclear winter" on our planet would be the last experiment in the history of man. (Footnote 1) (For more detail on this, see the selection "Fight Against War Before It Starts", PRIRODA, No 6, 1985, pp 3-62) There would be nobody to analyze the results. Such an "experiment" is not only criminal, but also absolutely senseless. At the same time, computer experiments with various mathematical models in this case are exceptionally important for the preservation of life on earth. And these experiments can be performed as many times as necessary.

Another example is studying the regularities of occurrence of hurricanes and predicting where they will go. The economic and social significance of this problem is evident. Experimental research in this case is certainly necessary (although sometimes dangerous), in particular for constructing an adequate mathematical model of the phenomenon. However, current knowledge and capabilities of technology are today clearly inadequate for experiments on artificial generation of hurricanes and control of their movement. But computer experiments with mathematical models of hurricanes are fully accessible and completely safe. So a reasonable combination of natural and mathematical experiments, it is believed, allows counting on a successful solution to this problem.

The number of similar problems in which mathematical modeling and computer experiments are moving to the forefront is growing rapidly with every day. It is interesting that mathematical modeling has now relatively long been used in designing the most varied objects: transportation facilities, power engineering machines, engineering structures, etc., and is inextricably linked to the concept of "computer-aided design." But in science itself, the aim of which is not designing a particular object, but obtaining new knowledge, it has somehow not (at least for the broad scientific community) become part of the concept of "scientific research automation." Therefore, without, under any circumstances, minimizing the significance of automating scientific experiments with real objects, we shall focus our attention in this article on some general problems associated with that aspect of scientific research automation which pertains to experiments with mathematical models. But for this, we need to know something, if only superficially, about systems programming.

Systems Programming

Defining this term rigorously and at the same time understandably is no simple matter. In any case, the dispute over whether systems programming should be considered a science or an art is still going on today. The author is more likely ready to endorse those for whom systems programming is a kind of engineering art requiring not so much a mastery of mathematical apparatus as an engineering intuition based admittedly on the logical mode of the intellect and a keen understanding of all the nuances in the operation of the hardware part of a computer, or, as it has come to be called among the specialists, the "iron." (Footnote 2) (The English term "hardware" is also widely used.) However, for our purposes, it is quite sufficient to consider systems programming as the complex of measures and software affording the optimal mode of operation of a computer and its users when any quantity and nature of problems are being solved with it. In this article, we need not define the term in more detail, nor need we decipher the word "optimal."

There are two different categories of systems programmers: Some develop systems software packages, others operate and maintain them. We shall be considering only the systems software packages themselves and those who develop them by enriching the "machine intellect." Unfortunately, there has apparently been almost no increase in such specialists in recent years in our country. The groups we do have are very small and moreover scattered throughout various organizations of various departments. Even before the "age of the Unified System computers," i.e. before the mid seventies, we clearly did not have enough systems programmers. Such underestimation of the role of systems programmers is perhaps due to the products made by them, the operating systems and translators from various algorithmic languages included in them, the data base management systems, the computer graphics systems and other systems (as well as problem or applications) software packages, not being considered a commodity by us up to now. That is, these products have been considered as having no monetary value and therefore not part of the famous "gross" cost of a computer (while the cost of these products abroad today makes up from 60 to 80 percent of the overall cost of computers). Therefore, apparently the most economical and productive operating system for the best (in particular, in terms of reliability) domestic computer for today, the BESM-6, was developed, however surprising this is, not by professional systems programmers, but by "amateurs," physicists from the Joint Institute of Nuclear Research and Institute of Nuclear Energy imeni I. V. Kurchatov. It is interesting that this computer, developed back in 1967, surpassed in its capabilities the "ancestor" of modern powerful operating systems, the English Atlas computer, which admittedly was produced somewhat earlier. I cannot help but cite another eloquent detail here. For their operating system, our specialists expended almost a thousand-fold less labor and resources than IBM, the famous American company, did on the 360 OS operating system (it is also the Unified System OS operating system). Despite that, its throughput is far higher than that of this foreign "monster".

Without discussing the features of computer operating systems in further detail, we shall use several examples in an attempt to trace the role of the systems software included in them, the so-called data base management systems for various purposes, and the programs for controlling computer graphics devices, in scientific research automation. (Footnote 3) (On data bases and data base management systems, see: V. B. Borshchev, "Data Banks and Bases," PRIRODA, No 3, 1982, pp 64-74; V. L. Perchuk, "Information Science: New Page in Research of World Ocean," PRIRODA, No 1, 1986, pp 29-40)

Computer Graphics

This is the part of systems programming concerned with development of software packages (and the hardware for implementation of them) for visual representation of data processed on a computer in the form of graphics and illustrations. After emerging in the beginning of the sixties, computer graphics immediately found use in computer-aided design; this allowed the designer to quickly reproduce and update results of computer computations directly on a display screen connected to a computer, and to output the final results as hard copies, i.e. various types of illustrations drawn by plotters. But in scientific research, using computer graphics amounted for a long time only to obtaining hard copies.

But after all, images created by using computer graphics offer researchers capabilities which immeasurably raise their productivity. These images reproduce an enormous amount of information in a form simple and convenient for perception, allow changing from the solution of one problem to another without labor, and can be used as a natural means of interaction between the computer user, the researcher, and the applications software used by him to solve a particular problem, in other words, between man and computer. And finally, these images themselves can be the object of study by using a computer.

But then interactive computer graphics, offering the capability of interaction, a dialogue, between the user and a computer gradually (far slower than one would like) began to be used in scientific research. Information which they exchange is reproduced on screens of color graphic displays.

In addition to other problems, associates at the Institute of Automation and Control Processes (IAPU) of the DVNTs AN SSSR [USSR Academy of Sciences Far Eastern Scientific Center] have also been engaged in the development of software for interactive graphic systems for scientific research automation for the last 15 years; a system of computer graphics unique in our country and capable of furthering scientific research automation to a considerable extent has been developed there.

Thus, research performed at the Institute of Automation and Control Processes has allowed modifying a domestic device in series production for communication between computers and intended for communication between various types of computers so that it can be used to connect the PERICOLOR raster graphics device with color display and built-in microprocessor to Unified System computers. New and effective capabilities of interactive computer graphics were thereby able to be implemented.

The systems software needed for operation of graphics devices includes the USSURI graphics data management system which was also developed at the Institute of Automation and Control Processes. It is intended for organization and storage of images (or rather, the information contained in them) on magnetic disks and tapes, and affords access to these images or parts of them from an applications program and transfer of them to a graphics system for further processing.

First generation graphics software and hardware, developed in the sixties and beginning of the seventies, allowed users to synthesize vector images, modify them and output the final results as hard copies. However, in time they no longer met the increased requirements of users and systems programmers engaged in computer graphics. In 1984, the International Organization for Standardization of Computer Graphics introduced a new standard for basic computer graphics software. It gives the user the capability of accessing computer graphics directly from his applications programs essentially independently of the type of hardware used to implement the graphics. Also, it seems it is far from always convenient for a user to work only with a fast general-purpose computer, even when his applications program is executable only on a "large machine." Thus, for example, sometimes it is more convenient to perform local analysis of an image itself in the interactive mode on a minicomputer (and in

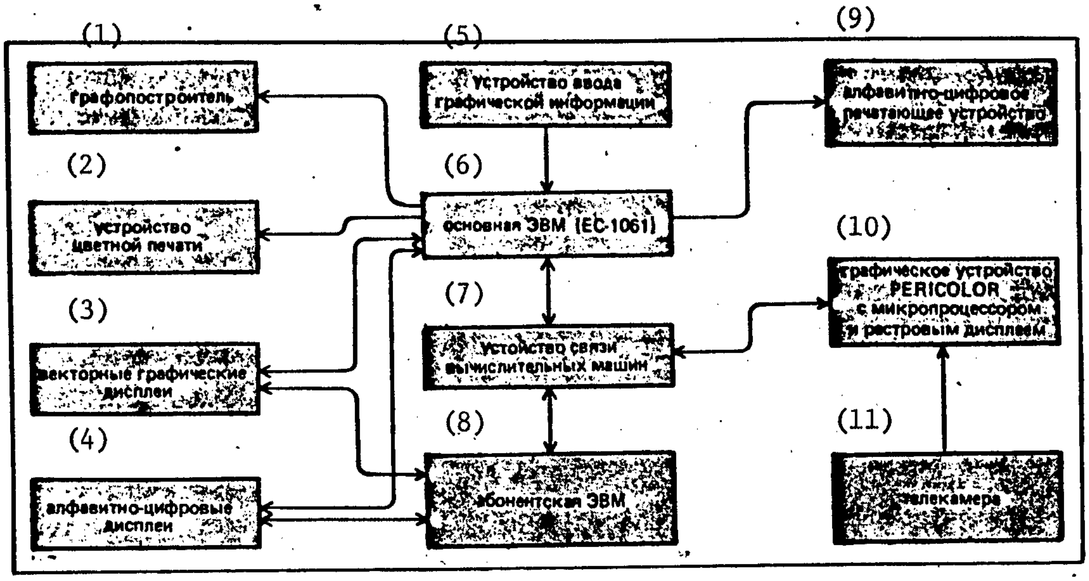

Fig. 1. Computer graphics hardware in operation at the Institute of Automation and Control Processes, USSR Academy of Sciences Far Eastern Scientific center

Key:

1. plotter
2. color printer
3. vector graphics displays
4. alphanumeric displays
5. graphics information input device
6. main computer (YeS-1061)
7. device for communication with computers
8. subscriber computer
9. alphanumeric printer
10. PERICOLOR graphics device with microprocessor and raster display
11. television camera

some cases even on a microcomputer), equipped with computer graphics and situated not far from a "large" computer to which it is connected by some communication device.

As a result, completely new requirements began to be imposed on computer graphics systems. This meant, in particular, decentralization, or distribution, of a graphics system between computers on different levels: Only part of the graphics system (and the applications program and data base needed for operation of this program and the graphics system itself) is placed on the main computer; the other part of it intended for execution, in the interactive mode, of separate instructions not directly related to the applications program and access to the data bases is placed on a subscriber computer on a lower level. But in the process, the main computer performs the computations according to the applications program, which accesses the appropriate data bases including graphics as required, and also responds promptly to

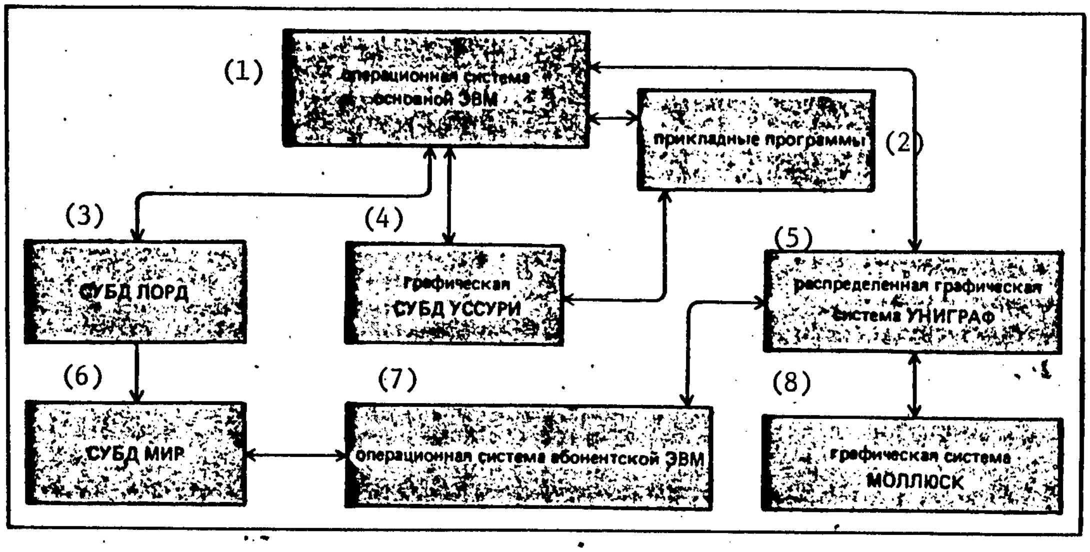

Fig. 2. Structure of software package for scientific research automation by using computer graphics

Key:

1. main computer operating system
2. applications programs
3. LORD data base management system
4. USSURI graphics data base management system
5. UNIGRAF distributed graphics system
6. MIR data base management system
7. subscriber computer operating system
8. MOLLYuSK graphics system

interrupts coming in from the subscriber computer with the individual requests by a user. The applications program is also charged with synthesis and some types of image modification. For this it interacts with that part of the graphics system which is kept on the main computer.

Of course, a user working at a display connected to the subscriber computer should not perceive that the applications program and everything needed to execute it are kept on the main computer; in a number of cases, he may not even suspect this. The optimal distribution of functions between both parts of a system presupposes the minimal exchange of information between the computers. For this, local processing of images should be executed in the interactive mode on the subscriber computer.

Such a distributed graphics system, which is called UNIGRAF, has been developed at the Institute of Automation and Control Processes. But the interaction between the applications programs and this graphics system is implemented by using the USSURI data management system independently of the specific content of the graphics data base where not just graphics images and their parts, but also text accompanying them, can be stored. The data management system allows a user to enter new information into a data base, select information entered previously from it, modify (edit) it in the interactive mode, delete unneeded information, combine different images into one (as is sometimes done on television, by reproducing different images in different parts of the screen), and perform many of his other requirements.

Scientific data used in the operation of applications programs is handled by the LORD (local processing of relational data) data base management system developed at the Institute of Automation and Control Processes. (Footnote 4) (For more information on this, see: V. L. Perchuk, op. cit.) Scientific data undergo processing which requires a large amount of external storage and fast response on the main computer. But packed (compressed) scientific data bases can be kept on the subscriber computer; these data can be processed by yet another management system, the MIR. Such data bases are advisable for applications programs, the individual parts of which can be executed on a minicomputer and which allow asynchronous interaction with the main program.

And now, having acquired an idea of the role of systems programming in general and computer graphics in particular in scientific research automation, let us illustrate their application in various areas with several examples.

Molecular Structures in Biology

About 30 years ago, the structure of some biological macromolecules was found by using X-ray structural analysis. One of the first to be successfully decoded was a molecule of chicken egg white, lysozyme. But we should explain what the word "decode" means.

Molecules consist of certain atoms configured a certain way with certain spacing. So in this case decode means to find out what atoms make up a molecule and to find the coordinates of each of them and the chemical bonds between them. Only after this can an attempt be made to represent the spatial structure of a molecule. This is how the spatial structure of DNK [DNA, desoxyribonucleic acid], the famous double helix, was discovered. By knowing the spatial structure of biological macromolecules, some biochemical processes with the participation of them can also be understood. In particular, the functions of their active centers can be analyzed, and the interaction of particular macromolecules, say polysaccharides, with ferments etc., can be investigated.

Thousands of biological macromolecules have already been decoded by now. The results of such decodings are kept in specially developed archives on magnetic information media. They have the form of tables for each molecule. However, it is difficult to imagine the spatial structure of a molecule containing several hundreds or even thousands of atoms. An outstanding spatial imagination is needed for this. And at the same time, it is extremely important to know what such structures look like.

Early models of biological macromolecule spatial structures were made from small, different colored plastic spheres (atoms) connected to each other by wires. They were truly unique since not only enormous amounts of labor and time, but also extremely high skill, were required to develop them. This is a good example of application of computer graphics capable of immediate reproduction of an image of these structures on color graphic display screens. Early representations of decoded macromolecule spatial structures by using computer vector graphics date to the end of the sixties. Within about 10 years, vector graphic systems were replaced by raster systems which are considerably more efficient for reproduction of large masses of information.

The problem orientation of computer graphics in the field of automated representation of molecular structure decoding results was furthered by the close contacts among associates at the Institute of Automation and Control Processes and the specialists from the Pacific Ocean Institute of Bioorganic Chemistry, USSR Academy of Sciences Far Eastern Scientific Center, who were extremely interested in this work and participated in it in the individual stages. As a result, the MOLLYuSK problem-oriented graphics system, designed to produce color raster images of molecules and study the spatial configuration of them, was developed. (Footnote 5) (T. A. Borovina and O. S. Kislyuk, KRISTALLOGRAFIYA, Vol 31, No 4, 1986, pp 827-828) As the first users, the scholars at the Institute of Crystallography imeni A. V. Shubnikov, USSR Academy of Sciences, and the Scientific Research Computer Center (in Pushchino) have already been able to appreciate the capabilities of it.

Data to generate images are input into the system as tables from an archive stored on magnetic disks connected to a YeS-1061 computer. In these images, atoms of various chemical elements are represented by different colored spheres; the size of them is a user option. The chemical bonds between atoms are represented by intersections of the spheres or rods connecting them. The system also allows output to a display screen along with an image of a molecule a list of atoms included in it, their coordinates and the bonds between them. Also, individual parts of a molecule (say, its active center) or atoms playing a special role in it can be marked by a special color. An image of an entire molecule as a whole or some parts of it is reproduced on a screen. But perhaps most important to a user: The graphics system can be used to rotate a molecule in space while observing it from different aspects and to observe the section of it cut by the plane parallel to the screen (in the process, the part of the molecule positioned behind the intersecting plane is depicted).

Also of great interest is the capability of "removing" atoms of a particular type from a molecule. For example, if all the atoms except one, the so-called C_α-atom, are "removed" in each of the amino acids making up the egg white while the remaining atoms of the various amino acids are connected by bonds, then a visual representation of how the chain of amino acids forming the egg white is situated in space is produced. Thanks to this, analysis of similarity of various egg whites in particular is considerably facilitated (see for example the figure on the first page of the cover [not reproduced]).

The MOLLYuSK system allows modeling illumination of a molecule by two light sources which creates a perception of the volume of the image of it on the screen. It can also be used to obtain not just images on a display screen, but hard copies on a color printer, and to make films of the internal dynamics of molecules and their interactions (based on mathematical modeling).

Without listing all the numerous capabilities of the MOLLYuSK system, which are continually being expanded, let us just note that it has been used with success in completely different fields too, including geology and geochemistry. For example, this system combined with the appropriate applications programs proved very useful for solving problems of predicting the bedding depths of the mineral cassiterite (tin stone) containing tin in a number of fields in the Maritime Kray. (Footnote 6) (S. D. Shlemchenko and E. D. Golubeva, "Using Methods of Multidimensional Statistics to Uncover Features of Microelement Composition of Cassiterite in the Silinskiy Field" "Tipomorfnyye assotsiatsii aktsessornykh elementov" [Type-morphic Associations of Accessory Elements], edited by S. A. Shchek, Vladivostok, 1985, pp 114-134) In solving this problem, a television camera connected to a microscope was used to output an image of transparent slides (microscopic sections) of crystals under investigation, sampled at various depths, to a display screen. The image was colored to particular conventional hues as a function of its tonality. Then microprocessor processing of the image revealed the color zonality of the samples and their element composition, which reflects the conditions of crystallization of the mineral at various depths. Thus, by comparing reference slides with samples of the deposits under investigation and combining analytic methods with computer processing of the images, the depth of the bedding and dimensions of the ore bodies can be predicted and exploratory drilling thereby optimized. It is believed that this approach, suggested by associates of the Far Eastern Geological Institute and implemented at the Institute of Automation and Control Processes, may also prove useful for prospecting for other mineral resources. But this is up to the geologists.

Computer Cartography

Computer cartography, as the making of maps by using a computer is called, can also perhaps be considered a direction of scientific research automation. Actually, a large number of institutions, including scientific, are engaged in compiling various maps. These are primarily geographical and meteorological organizations, and institutes and laboratories engaged in ecological problems, the study of forests, soils, water resources, etc. No less important also is the role of maps in geology, oceanology, and a number of other fields of human activity. A complete list of them would probably be tiring and unwarranted since it is so clear that computer cartography can transform the nature of the labor of the broadest ranges of scientific workers.

Research in this field has been seriously pursued at the Institute of Automation and Control Processes. As a result, today we have systems, and in particular graphics, software for automation of cartographic operations. Let us mention here just two capabilities which have been opened to users in connection with this. First is the development of specialized problem-oriented (thematic) maps with particular required characteristics in less time and with less cost; second is the automation of the majority of routine operations which are inevitable in compiling maps (sorting of data files, construction of a geographic grid, application of various marks, legends, etc.).

Let us briefly describe the computer cartography software components. The software package is based on a cartographic data base for some region, represented as a digital terrain model. All the new data obtained by the most varied methods must go into this base. In any work related to developing new maps, the data needed are extracted from this base. The cartographic data base is managed by using the USSURI system mentioned earlier. For this purpose, this system proved optimal among all known data base management systems. In particular, as noted earlier, it is convenient not only for graphics data, but also for text.

Local data bases, including the current base of digital maps and the conventional symbol library data base, are also used along with the general cartographic data base.

The necessary fragments of terrain descriptions are entered from the cartographic data base into the current digital map base. But here all objects are brought to a common scale and projection; other conversions required for map compilation are performed; as a result, a source digital map is produced. Descriptions of conventional symbols and legends are stored in the conventional symbol library data base. Let us note that the descriptions are not stored in the traditional form in which each description characterizes some object. To optimize data base operation with respect to both time and machine memory used, descriptions of all the symbols in the library are classified in a certain way, and the procedures to reproduce them are standardized.

The second independent component of the software is the cartographic data reproduction system. Cartography imposes special requirements on smoothness of isolines, placement and order of application of legends, etc. Therefore, the reproduction provides for:

representation of relief and any physical fields by maps of isolines;

designation of objects on maps by conventional symbols adopted for thematic maps of a particular type;

computation and construction of mathematical base of map, etc.

It would appear that construction of isolines is not especially difficult; after all, there are well known methods of interpolation. However, solving this problem in practice has proved rather complex and ambiguous. The fact is that the full-scale survey data that go into the cartographic data base, as a rule, are irregular, and sometimes inaccurate or even wrong. Therefore, filling in, checking and correcting of data are required. And the data density and validity, relief nature and complexity and, finally, the capacity of the user's computer resources seriously affect the selection of the specific interpolation algorithm. Also, isolines have to be drawn with the specified accuracy; in the process, the smoothness of them must be controlled efficiently; breaks and self-intersections are not allowed. Thus, before deciding on a certain algorithm, it is advisable to model various categories of relief, methods of specifying source information and other factors to assess the adequacy of the modeled surface produced as a result of interpolation. The interpolation program library, provided for in the system, allows purposeful selection of an interpolation algorithm for each specific case through modeling.

The third component of the software package is the cartographic data input system which allows using the most varied devices for information input and acquisition technique. This is achieved through standardization of the input data format. The system provides the capability not only for data input, but also for data checking, correcting and even local processing. The system also allows combining data for various sectors of terrain and exchanging data between various cartographic data banks.

Finally, the most important component of the computer cartography package is the graphics system itself and the interactive monitor which affords communication between the user and all the software components. The experience gained at the Institute of Automation and Control Processes confirms the high efficiency of the interactive mode in computer cartography. For example, the application of legends to the maps is considerably simplified in the interactive graphics mode. After all, the legends have to be applied uniformly over the entire plate, oriented along the isolines, and placed only on straight-line or slightly curved sections of them. There is also no question that it is more convenient to edit maps in the interactive mode.

All this software not only already exists, but is also successfully being used so that cartography automation has been realized today to a considerable extent (admittedly, as a rule, this is not even known in the organizations mentioned above at the beginning of the section). (Footnote 7) (V. I. Govor, "Graphics Software for Problems of Automation of Cartography," "Problemy mashinnoy grafiki i tsifrovoy obrabotki izobrazheniy" [Problems of Computer Graphics and Digital Processing of Images], Vladivostok, 1985, pp 146-147; idem, Development of Software for Automation of Cartography," "Avtomatizatsiya issledovaniy i analiz geograficheskikh dannykh" [Automation of Research and Analysis of Geographic Data], edited by V. L. Andreyev, Vladivostok, 1985, pp 92-100) In the next phase, it is planned to focus attention on automating compilation of various thematic maps and developing a distributed cartographic system similar to the graphics system discussed above.

Prospects and Problems

Just what are the prospects of using systems programming in scientific research automation? It is believed that the main direction of the evolution of it in this field is tied to the maximal use of global and local computer networks and the creation of distributed scientific data bases. (Footnote 8) (Computer networks and distributed scientific data bases were discussed in the article by V. L. Perchuk mentioned in footnote 3) At the same time, distributed graphics systems, not with fixed software components as UNIGRAF, but with dynamic distribution of functions among them, should be implemented in computer networks. Modern personal computers with a complete set of graphics devices, raster color graphics display and appropriate direct access memory may have a great impact on scientific research automation. This influence will be intensified especially when 32-bit personal supercomputers will have begun to be produced in series. Connecting them to all kinds of computer networks will decisively affect the efficiency of scientific research essentially in all directions.

But of course the "human factor" will still be of major significance in the future too. The time spent on obtaining results and the quality of them will depend (but then, they depend already even today) on the skill of the scientist in any specialty, both in the field of his scientific interests, and in the use of modern computer technology, to organize and implement scientific research. And this will require considerable readjustment from many. In particular, the requirements for ideological value of scientific work will increase perceptibly. After all, it is no secret that sometimes essentially, purely routine engineering such as construction of graphics or compilation of the same maps is passed off as scientific work.

Systems programmers with the highest skills are called upon first of all to implement these prospects which capture the spirit and to ensure genuine intensification of scientific research. Let us then wish them a successful and, where possible, speedy solution to this problem which is important to science as a whole (and not just to science).

PHOTO CAPTIONS

1. p 51. Viktor Lvovich Perchuk, doctor of engineering sciences, member of the Presidium of the Far Eastern Scientific Center of the AN SSSR [USSR Academy of Sciences], director of the Institute of Automation and Control Processes of the DVNTs AN SSSR [Far Eastern Scientific Center of the USSR Academy of Sciences], professor of Moscow Institute of Engineering Physics. Main scientific interests involve the study of control processes in complex systems and systems programming as a base for scientific research automation. His article, "Information Science: New Page in Research of World Ocean," was published in PRIRODA, No 1, 1986.

2. p 51. Section of the machine room in the computer center at the the Institute of Automation and Control Processes, USSR Academy of Sciences, Far Eastern Scientific Center

3. p 54. Examples of use of computer graphics to represent structures of biological macromolecules.
A -- section of molecule of panaxozide [organic matter extracted from the famous ginseng at the Pacific Ocean Institute of Bioorganic Chemistry]. Atoms of various chemical elements are depicted as different colored semitransparent spheres [in this and the other photographs selected for publication, the conventional colors of the chemical elements do not always match the generally accepted notation in which white is used for carbon, red for oxygen, blue for nitrogen, yellow for sulfur, etc.]. Sphere size corresponds to the so-called van der Waals radius, equilibrium space between atoms in a molecule. Rods visible through the semitransparent envelope of the spheres symbolize chemical bonds of atoms in the molecule.

4. p 55. B -- use of color to study states of atoms in a molecule of fragment of ribonuclease C_2. Atoms with low amplitudes of oscillations are shown in "cool" colors [from violet to light blue]; those with high amplitudes are shown with the "warm" colors [from yellow to red].

5. p 59. Image of cassiterite crystal [sample size is 0.5 mm] input into computer by using a television camera connected to a microscope. Natural monochrome [brown] color of crystal has been transformed into conventional colors in accordance with intensity of it for various zones of crystal. Computer processing of image reveals properties of spectrum of this color in various zones of crystal. [Result of one of intermediate stages of processing is shown on the right on the first page of the cover. The spectrum is shown on the fourth page of the cover.] [not reproduced] Based on this, mineral crystallization features and thereby depths and sizes of deposit, at various levels of which samples intended for study were selected, can be judged.

8545
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ELECTRONIC INFORMATION AND TICKET SYSTEM AT CENTRAL RAILROAD BUREAU

Moscow VECHERNYAYA MOSKVA in Russian 9 Feb 87 p 2

[Article by A. Artemev: "Dialogue With a Computer"]

[Text] Today, a new television installation went into operation at the Central Railroad Bureau (CRB).

It informs passengers about the availability of seats on trains for all directions. And the rest of the time it is possible to watch an advertisement or a television broadcast on this color television.

Having spent these days at the office on Komsomolskiy Square it is possible to see other innovations.

cashier's table, are placed in the spacious hall on the first floor. I approach one of the screens. In two weeks I am to go to Kiev, so I "ask" the computer if there is a seat.

From the timetable hanging nearby, I select the appropriate train to the Ukrainian capital. With the help of a simple code, I punch in the number of the train, the station destination, and the day of departure. The computer immediately gives the complete information: how many and which seats are available in the coach, reserved, and sleeping cars, and cars of the "SV" type.

If, let's say, there are no tickets for the necessary train, it is possible to obtain information about other trains bound for the destination point. I also was interested in how things stood regarding tickets for the return trip and once again received a comprehensive answer.

I observe the other passengers. By the smiles and conversations it seems like the electronic information system appeals to them. The arrangement is simple to use so that each person easily receives information in less than one minute. Together with the head of the Central Railroad Bureau, Yu. Novakovskiy, we drew up a short trip.

"The automated system with which you just became acquainted is called EKASIS", he said. Now all our branch buildings are equipped with such displays. Use of the new hardware permits improving information for the passengers. Our aim is creation of automated work places for all our employees.

Yes, many places have already been done. The Information Bureau has begun to answer more quickly the questions of the subscribers -- since "EKASIS" appeared on their desks they do not have to look for the necessary information in numerous reference books.

Use of electronics noticeably improves delivery of tickets to Muscovites at home or at work. Having taken an order by phone the operator on the spot sets up the data about the trip on the terminal "EKSPRESS-2", receives the tickets, and puts them in an envelope. The third day after receiving the order, they deliver the tickets to the customer strictly reserved for him at two o'clock.

Soon the self service room at the CRB opens... for ticket sales. It will resemble the principle of today's electronic inquiry office. With the only difference being that the passenger not only receives an answer, but reserves his own seat on a certain train. The printing mechanism issues a special coupon on which all information about the tickets will be indicated. The cashier will issue travelling documents to the passenger according to the coupon. By preliminary calculations such a form of service allows the cashier on duty to sell two to two and a half thousand tickets which is five to six times more the than present rate.

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COMPUTERS IN GDR AGRICULTURAL SECTOR

Moscow SELSKAYA ZHIZN in Russian 30 Jan 87 p 3

[Article by Rudi Meyer: "A Dialogue with the Computer" under the rubric "From the Experience of Our Friends"]

[Text] Computers are playing a growing role in agriculture as in other sections of the economy in the German Democratic Republic. There are several examples of how the successful application of this technology is organized. The Cooperative at Dyurveytsshen (the district Leipzig) can serve as one such example. The Cooperative has close to three thousand hectares of arable land and on 2.6 thousand of these are grown fruit, basically apples.

In the course of the last ten years the computer base of the economy has developed from the purchase of separate office and micro computers to the creation of a computer network. In basic ways it already exists, but for the present the question of a link up of the computer facilities of the departments and the main network has not been decided to the end. The main computer, PRS-4000, of the production group "ROBOTRON", operates at the computer center. The work place of each manager on the department level and higher is equipped with a personal computer. It is necessary to emphasize that wide-spread application of the computer is based on the long-term task of training the personnel. The manager of the center is a specialist in Informatics and Computer Science. Service to the computer is carried out by their own forces.

All information about the course of the production process is stored in the machine's memory. More than 40 computer plans which apply to all departments, crews, and the domestic and international economic problems of enterprises are used at the Cooperative. Since 1977 the volume of production has more than doubled and the number of workers has grown 163 percent, but the management staff has been cut. It has been determined that the introduction of computers released more than 30 workers whom, under former conditions, it would have been necessary to enlist additionally to fulfill increasing tasks. But the most important result ought to be considered the representation of all sections in the production process, the placement of timely information at the disposal of all working collectives, and a scientifically valid basis for decisions on all levels of management.

Are such specific problems as these solved with the help of a computer? We will relate some of them. Forecasting a harvest according to sections, crews, and fields allows the possibility of determining beforehand the requirements in the work force and means of production during the harvest. Daily recording of results permits effectively controlling its course. The comparison of planned goals and achieved results calculated on the computer is brought monthly to the crews. With the help of a computer in the sections even the labor results are estimated and the earnings in all of more than 1000 temporary assistants are calculated.

The cooperative has over 800 partners in wholesale and retail trade. The computer helps to keep an eye on fulfillment of deliveries, internal economic and foreign contracts and on utilization of the packaging service, to take stock of material resources, and to carry out and control financial operations.

An important sphere of application for the computer is stimulation of the economy of materials and energy and organi-zation of competition according to these results, and the guaranteeing of the optimal use of machine and tractor fleets. There is documentation on each tractor, machine, and mechanism with data about the condition of individual parts and joints in the memory of the computers. With the help of such information it is possible to prolong the service life of the machines and investigate reasons for wear and tear. Already today it is difficult for machine operators to imagine organizing repairs and maintenance of equipment, calculating the expense of spare parts, and combustibles and lubricants without the help of a computer.

So the scientifically sound introduction of computers is becoming the technical basis of rational management of the economy. In due course the computer will be even more deeply instilled in other spheres of the production process.

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THE SECOND YEAR OF THE FIVE-YEAR PLAN

Moscow STANDARTY I KACHESTVO in Russian No 1, Jan 87 pp 4-5

[Unsigned editorial: "The Second Year of the Five-Year Plan"]

[Text] The second year of the 12th Five-Year Plan has begun, which, as has been noted by the conference at the Central Committee of the CPSU on introduction of government acceptance control, holds a key place in the 15-year program.

This year's plan rests on a solid foundation built in 1986, when we attained a growth of the gross national product and industrial production which was the highest in the 1980's.

The plan of the second year of the five-year period focuses attention on reinforcing and developing the positive shifts in the economy that have been achieved and on bringing into effect more fully the long-term growth factors of the national economy. The plan fully complies with the course drawn by the 27th Congress of the CPSU toward accelerating the socioeconomic development of our society and meeting the targets of the 12th Five-Year Plan.

It is an important feature of the plan for 1987 that it is based on a fuller utilization of productivity factors. The growth rates, therefore, will be higher than was planned for the first year of the five-year period. The gross national product is to increase 4.1 percent, as compared with 3.9 percent in 1986, and industrial output by 4.4 percent as against 4.3 percent. Labor productivity in the industry is to grow by 4.4 percent.

Conditions are created in the economy for achieving high growth rates of output, productivity and profits and reducing production costs.

Faster growth in all sectors of the economy will allow us to continue to improve the living standards of the Soviet people and to promote advances in the social sphere. Approximately three-quarters of the increment in the gross national product is planned to be channeled into improving the welfare of the people.

A key feature of the new plan is the decisive move toward drastic improvement of product quality in all sectors.

Specifically, the proportion of basic engineering products that conform with the world quality standards in 1987 is to be increased by 1.6 times, so that by the end of the five-year-plan period it will be doubled, reaching the target set by the 27th Congress of the CPSU.

Guided by the decisions of the 27th Congress of the Party, the plenums of the Central Committee of the CPSU and the resolution of the the Central Committee of the CPSU and the USSR Council of Ministers "On Measures Toward Drastic Improvement of Product Quality," Gosstandart [State Standardization Committee] of the USSR has approved the National Standardization Plan for 1987.

Ministries, departments, union republics, leading and basic organizations and scientific research institutes of the Central Committee and of its affiliate organizations in 1987 will work to provide the necessary support in terms of standardization and metrology for solving the major national economic problems in raising the technological standards and engineering product quality up to the world level, in developing the fuel and power complex, in implementing the USSR food products program and in stepping up the nation's social development.

It is a characteristic of the National Standardization Plan that it:

is aimed at active work to revise standards so as to bring by the end of the 12th Five-Year-Plan period the entire collection of national standards up to the world level; and

includes provisions for switching over to an optimal organization of the pool of standards.

All industries are faced with an important task: by the end of the 12th Five-Year-Plan period they must bring all national and industry-wide standards for products and all specifications up to the world level. To this end, in the next four years it is necesary to develop, revise, amend, prolong or abolish about 6400 national standards, which includes bringing into compliance with world standards 700 national standards in 1987. In the field of engineering the proportion of standards conforming to world requirements will be almost doubled.

Regarding standardization as a major tool for intensive productivity increase, the plan for the current year pays much attention to its further growth in width and in depth. The ministries of engineering industries are expected to improve the level of standardization for 113 major types of machines and equipment and to expand the use of typical industrial processes, standard or resettable production tools and standard, adjustable and modular equipment.

These efforts will make it possible to optimize the set of types and sizes of machines, equipment and instruments and to create on this basis standardized block-modular and basic designs and substantially increase the output of standardized products as a share of total engineering output.

The plan for 1987 calls for drafting about 700 national standards with future-oriented requirements, so that with the results of work done in 1985-1987 a file of such standards will be created that would cover all groups of similar products, including the most important items.

In accordance with the resolution of the USSR Council of Ministers of 14 Jan 1986 No 65 and the resolution of Gosstandart of 27 Jun 1986, a project has been completed in organizing and optimizing general technical and organizational-methodological standards. (footnote 1) (See STANDARTY I KACHESTVO, No 9, p 12, 1986; No 1, 1987.) It was decided that 15 out of 36 systems of standards that were in effect could be abolished. As a result of work conducted in 1986 to this effect, 168 standards were abolished, 285 were updated, 47 were emerged and 70 were reclasified as guidelines or industry-wide documents.

The plan for 1987 focuses on the development and improvement of systems such as GSS [national standardization system], SAPR [computer-aided design systems] and SRPP [system of product development and introduction], so as to bring them into conformity with the needs of accelerated scientific and technological progress.

The plan includes assignments for development and improvement of GSS with regard to reducing standard drafting time and improving the cost-effectiveness of standardization.

With regard to computer-aided design, 20 technical-normative documents are to be prepared which will define the basic principles of such systems, the organization of work in creating them, the methods for work on priority research and the creation of invariant components and programming-methodological software packages for CAD. This will include cancellation of 15 national standards, which will be replaced by one standard and one instruction.

For the System of Product Development and Introduction the plan for 1987 calls for creating a complex of 16 national standards which will cover all aspects of work organization in terms of the stages of the life cycle of a product with regard to large-scale, batch and unit manufacturing. As a result, the interaction of the participants in the creation of new technology will be greatly simplified, and the designers will be given broad authority in the choice of concepts and technical decision-making. It should be noted that as of 1 Dec 1986 a large number of industry-wide SRPP standards have been abolished because they introduced complications into the process of creation and introduction of new technology.

The draft plan also envisions improvement of such systems as ESKD [Unified System of Design Documentation], the Unified System for Classification and Coding of Technicoeconomic Information for ASU [management automation systems], etc.

Altogether, in 1987 more than 1500 national standards are to be created or revised.

An important aspect of standardization efforts in 1987 will be the technical-norm support to the implementation of the Comprehensive Program of Scientific and Technological Progress of CEMA Member Nations up to the Year 2000 and agreements on specialization and cooperation of industries of these countries.

The draft National Standardization Plan in the section concerned with the development of CEMA standards [STSEV] for 1987 includes 1899 assignments, of which the USSR will be responsible for 657.

In the field of international standardization, the draft plan for 1987 calls for further development of work done under the auspices of those technical committees of ISO [International Standardization Organization] and MEK [International Electrotechnical Commission], whose secretariats are headquartered in the USSR. This section of the plan includes assignments on the development of international standards of ISO and MEK. The total number of draft standards to be developed under the programs of technical activities of ISO and MEK is close to 3000.

It should be noted that according to the resolution of the Central Committee of the CPSU and the USSR Council of Ministers on "Measures Toward Drastic Improvement of Product Quality" the use of international standards in the national economy in 1987 must be grealy expanded. In particular, 443 STSEV are to be introduced in the USSR, which means that by the end of next year the total number of STSEV in effect in the USSR will rise to 4898 (of a total of 5800).

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IMPROVEMENTS OF INTERINDUSTRY SETS OF STANDARDS: A MAJOR CHALLENGE FOR STANDARDIZATION

Moscow STANDARTY I KACHESTVO in Russian No 1, Jan 87 pp 22-25

[Article by M.A. Dovbenko, chief of Technical Administration of Gosstandart: "Improvements of Interindustry Sets of Standards: A Major Challenge for Standardization"; published under the rubric "Theory, Methods and Practice of Standardization: Systems of Interindustry Standards"]

[Text] General-technical and organizational-methodological standards are an important component of the common pool of normative-technical documents, which reflect the current stage of science, technology and industry.

In the past 10 to 15 years considerable experience has been gained in the Soviet Union with the use of standardization in the solution of major interindustry organizational-methodological and general-technical problems.

In accordance with guidelines from the party and the government, systems of standards have been developed to cover such areas as establishing a unified nationwide procedure for developing and introducing new products (1973-1975), introducing an efficient system of preparation of production (1973-1976) and others.

In view of the efficiency of a comprehensive and systemic approach, systems and complexes of standards were developed vigorously. The pool of interindustry organizational-methodological and general-technical standardization documents has been growing steadily. By 1985 there were more than 30 interindustry systems (complexes), totaling some 2500 national standards and about 500 RD [guideline documents] of Gosstandart. In addition, a substantial number of oganizational-methodological standards have been developed that are not part of any of the systems or complexes. The store of normative and technical documents that has been accumulated has had a positive contribution to the development of society's productive forces.

Yet today, after the 27th Congress of the CPSU has set the goal of intensifying economy, restructuring economic mechanisms and drastically improving product quality, it became necessary to appraise the past experience with self-criticism and spot and remove whatever stands in the way of utilizing the potential of standardization for meeting the cardinal goals of economic development. This requirement applies fully to inter-industry organizationl-methodological standardization whose vigorous development has created a number of problems and negative effects.

The experience of the industry and studies by the institutes of Gosstandart have revealed the following shortcomings in this area of standardization:

unjustified proliferation of standards and the aspects of activity they encompass, especially in the sphere of technical creativity and management;

insufficient organization of the pool of acting standards, so that engineers designing new products are often incapable of complying with all of them;

regulation by standards of aspects which are the prerogative of other agencies of government administration;

overloading of standards with secondary indicators and ratings inaccessible to verification;

rigid regulation of the methods of execution of various operations and sometimes even methods by which the choice of implementation should be made;

an excessive number of approvals required for technical and normative technical documents and the mandatory requirement of preparing a number of subsidiary documents which do not directly affect the creation and introduction of new products; and

inclusion of standards for specific products in interindustry complexes.

The need for a drastic reorganization of the entire pool of interindustry standards and RD is thus obvious.

Gosstandart and its institutes in the past have also done some work to organize and improve organizational-methodological and general-technical standards. This work was systematic, offering a new vision of the entire pool of standards currently in effect and its influence on the processes of new product development. In particular, it became clear that the number of standards must be limited, that the systems (complexes) must be inter-coordinated more closely, duplication and inessential requirements should be eliminated, the sets of standards should be linked more immediately with the phases of the life cycle of a product and the influence of each set of standards and each standard on ways of improving product quality should be evaluated.

The need was recognized for an integrated scientific and methodological guidance of the efforts in organizing and improving the organizational and methodological regulations (statutes, specifications, norms, etc.).

The new philosophy of organizational and methodological standardization was reflected in the efforts toward the improvement of the complex of standards, "National Standardization System" [GSS]. The 1985 version of GSS sets forth more stringent requirements for organizational-methodological and general-technical standards. GSS-85 specifies the principal objects to be covered by these kinds of standards. It is also specified that general-technical and organizational-methodological standards should typically be grouped into complexes which address the respective aspects of national economy or social sphere in a systematic way.

The standards included in the interindustry complexes have been assigned special codes, where the first two digits followed by a period indicate the complex to which the document belongs.

The requirements for interindustry organizational-methodological and general-technical standards are to ensure that they are indeed of an interindustry nature and are not tied to some narrow group or class of products.

Seeking to provide conditions for faster development and introduction of new and modernized engineering products, the USSR Council of Ministers issued a decree on 14 Jan 1986, making it incumbent on Gosstandart, ministries and departments and the councils of ministers of the Union republics to take all the necessary steps for simplifying the procedures of development of technical documentation for new and modernized products. Gosstandart was ordered to remove from national standards methodological principles and procedural requirements regulating how the work in creation and introduction of new technology should be conducted, with the intent that, if necessary, such information could be included in materials of a nonbinding recommendatory nature.

In this context, Gosstandart and its institutes stepped up their work of putting in order interindustry systems and complexes of standards. As early as July 1986 they revised and updated 285 national standards, abolished 168 standards, reclassified 70 standards as RD or industry-wide NTD [normative-technical documents]. Changes have been introduced into the National Standardization System, the System of Product Development and Introduction and standards complexes ESKD, ESTD, ESTPP and others, greatly simplifying the procedures of developing, coordinating, and approving normative-technical, design and production process documents.

Some of the programs of development and improvement of the systems (complexes) of standards were revised and detailed, and similar changes were introduced into the national standardization plan "Development of Systems of General-Technical and Organizational-Methodological Interindustry Standards in 1986-1990."

Fresh impetus to this endeavor has been given by the resolution of the Central Committee of the CPSU and the USSR Council of Ministers "On Measures for Drastic Improvement of Product Quality" of 12 May 1986, which called for achieving a high scientific and technological level and optimal composition of the principles, rules and norms included in these standards.

Based on the results of a comprehensive analysis of the systems (complexes) of interindustry standards by Gosstandart institutes, the following five priority areas have been determined on which to concentrate the further development and improvement of interindustry standards in 12th Five-Year-Plan period. These include developing:

1. rules for standardization projects (National Standardization System [GSC]);

2. basic rules for the conduct of work at all stages of the life cycle of a product (The System of Product Development and Introduction [SRPP], the Unified Ssytem of Technological Preparation of Production [ESTPP]);

3. standard rules securing informational consistency (Unified System of Design Documentation [ESKD], Unified System of Technological Documentation, Unified Systems of Documentation, Unified System of Programming Documentation, Uni- fied System of Standards of Automated Management Systems and Unified System of Classification and Coding of Technicoeocnomic Information);

4. standard rules and norms of metrological services and ways of ensuring consistency of measurements (National System of Measurement Unification); and

5. general-technical rules, norms and requirements regulating the common and important properties of products (Unified System for Protection from Corrosion and Wear of Materials and Products, System of Industrial Safety Standards, System of Standards "Technological Safety," System of Standards of Ergonomic Requirements and Ergonomic Support and Unified System of Tolerances, Settings and Basic Interchangeability Norms).

Gosstandart has decided to better organize a number of systems (complexes) of standards proceeding from an analysis and determination of the major trends of future work in standardization of organizational-methodological and general-technical rules concerned with the development, production and use of products, a drastic reduction of the product development time and improvement of engineering precision and quality, as well as in order to eliminate the shortcomings that have been identified.

In particular, complexes of standards have been abolished which were comprised of standards that:

were of a methodological nature (GOST 18, "Quantitative Methods of Optimization of the Parameters of Standardization Objects"; GOST 23, "Measures to Provide Stability of Products to Wear and Tear"; GOST 25, "Calculations and Strength Tests in Engineering"; GOST 23554, "Expert Methods of Quality Evaluation"; GOST 23945, Unification of Products"; and also a number of standards in the complexes "Cost-Effectiveness of Standardization" and "Applied Statistics");

have not been in general use in the industry (GOST 16, "Control of Technical Processes"; GOST 28 "System of Equipment Maintenance and Repair"); and

failed to become the subject of further development (GOST 24865, "Holography and Holographic Methods of Quality Control"; GOST 26347, "Unified System of Codes of Materials").

Interindustry complexes of standards covering specific classes and groups of products for which leading industries have been defined on a national basis have also been abolished (GOST 26, "Unified System of Standards for Instrument Making"; GOST 31, "System of Standards for Process Engineering Equipment").

It has been decided to abolish GOST 25051, "System of Government Product Testing."

At the same time, it has been decided that a national standard "Government Testing of Products" should be developed and submitted for subsequent approval as part of the complex of SRPP standards. This provides for a closer coordination of the requirements for government tests and the organizational aspects of product development and introduction as regulated by standards of the SRPP complex.

One may ask if cancellations of systems mean that their national standards or other NTD are abolished completely. The answer to that is an unconditional no. The entire positive scientific and technological potential embodied in the standards or other NTD that make up part of the above complexes and are being abolished should not be lost as the standards are merged, revised or cancelled.

NII Gosstandart [Scientific Research Institute of Gosstandart] and the sections of its NTS [scientific and technical board] are currently engaged in studies to determine which of the standards should be retained as nationally binding documents after the necessary work has been done on merger, revisions and abolition of some of the standards in the complexes and which should be cancelled or reclassified as methodological documents, such as RD, etc.

Proposals are being drafted on cancelling obsolete methodological documents which have lost their current validity or duplicate industry-wide or other documents and to reclassify some of the standards and RD as industry-wide documents.

As regards the systems and complexes of standards that are retained, work for their improvement should become the permanent concern of all standardization agencies and services and Gosstandart institutes responsible for the respective NTD complexes. The overall methodological guidance and coordination of work on ordering, improving and expanding interindustry systems (complexes) of standards are to be provided by the All-Union Scientific Research Institute of Standardization [VNIIS].

Work to upgrade the systems (complexes) that are to be retained is done by working groups with participation of experts in main industries.

In addition to updating interindustry standards belonging to the various systems or complexes, it will be necessary in the near future to review the pool of organizational-methodological and general-technical standards which are not part of such systems or complexes. The studies of such "extra-systemic" standards will lead to their revision, with eventual cancellation of inessential standards, or their incorporation in the appropriate complexes.

Currently, the leading standardization organs of all industries should analyze the industry NTD pools developed on the basis of and in supplement to the interindustry general-technical and organizational-methodological systems of standards and to either cancel some of the industry-wide standards or, if necessary, reclassify them as recommendation documents.

The decisions that are made must be brought to the attention of the industry if the work on improving interindustry organizational-methodological standardization is to be successful. Inspections by Gosstandart at enterprises in several engineering industries indicate that work in bringing into a system and upgrading interindustry organizational-methodological standards for development of new products and improvement of their technical level and quality proceeds at an inadmissibly slow pace. One of the reasons for this is lack of information. It even happens that product developers, designers and process engineers learn about new decisions from publications in newspapers and magazines. Improving communication between Gosstandart agencies and industrial enterprises and more active work by leading and basic organizations are a pressing demand of the times.

An important role in providing feedback to Gosstandart from the industry is played by the Council of Chief Designers at Gosstandart, created by a decision of the Bureau for Machine Building of the USSR Council of Ministers. This body is concerned with the basic organizational and technical aspects involved in improving the procedures of product development and introduction and other general key aspects of standardization. In particular, the members of the council have directly contributed to the development and adoption of GOST 15.005-86, "SRPP: Single-Items and Small-Batch Products Assembled at Operation Site," effective as of 1 Jan 1987. The adoption of this standard will help to greatly reduce the development time of new technology. Such direct communication links between Gosstandart and industries should be reinforced by creating similar councils with oversight of specific major problems under the auspices of Gosstandart institutes. Participation of leading experts in discussions of these councils will help them arrive at sound decisions and accelerate the introduction of new standards after approval.

The improvements of interindustry organizational-methodological standards should draw from experience of advanced enterprises in the industry. For example, the complex method of new product development put into effect at

Ivanovo Machine Tool Building Association imeni 50th Anniversary of the USSR, which calls for parallel work on developing new products and initiating their production, has been reflected in revision No 9 of GOST 15.001-73, which legitimized combining the stages of product development and production startup. Similarly, in the future, standards should make use of all advanced and progressive technologies tested in practice by the best enterprises.

Efforts to improve the systems and complexes of organizational-methodological and general-technical standards will help increase the contribution of standardization to faster scientific and technological progress, industrial modernization and the raising of product quality up to the level of best world models, as called for by the resolutions of the 27th Congress of the CPSU.

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THE PLUSES AND MINUSES OF THE NEW SYSTEM OF CODES

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[Article by Yu.P. Shevel and Yu.P. Lyubushkina, VNIIstandartelektro [All-Union Scientific Research Institute of Standardization in Electrical Engineering]: "The Pluses and Minuses of the New System of Codes," published under the rubric "Classifiers and USD [Unified Documentation System]"]

[Text] The system of codes for products and design documents in the ESKD [Unified System of Design Documentation] has been discussed in the press for almost 15 years, and the debate has been joined by a large number of experts in various industries, emphasizing the importance of this problem. Even before the ESKD Classifier was created, many authors noted that the lack of a unified system of codes for products and design documents was a shortcoming of ESKD which reduced the efficiency of introduction of new products [1]. At present, after the approval of GOST 2.201-80 and ESKD Classifier, a number of specialists have argued that it is inadmissible to reorganize drastically the systems of codes of design documents that have been in use at the enterprises and in the industries for a long period of time [2].

For example, in the article "On Introduction of GOST 2.201-80 and ESKD Classifier" [3] the authors analyze the existing code systems and ESKD Classifier and suggest that the systems of codes used by industrial enterprises should be retained, but, at the same time, a new classifier should be developed, taking as a "prototype" the interdepartmental classifier NO.000.005, widely used in instrument-making industry.

The idea of introducing a unified system of codes for products has been aired for a long time. "Why is it that this simple and evident idea has yet to be implemented?" asked the authors of [3].

Taking the electrical engineering industry as an illustration, one can trace the stages that have determined the development and introduction of a generic system of product codes.

In early 1936 the manufacturing of all electrical engineering products in the country was regulated by 44 standards, specifying the general requirements, norms and testing methods. The production operated on a small-batch or single-item basis. Electrical machines, for example, were not standardized; the power, size and installation and attachment dimensions were specified by the consumer.

Optimal decision-making in the design of new products did not involve analysis of large amounts of information, nor did it require mathematical tools and computer technology to process this information, even if these tools existed at the time. An object-based system of coding was convenient and easy in these conditions.

During the Great Patriotic War and in the postwar economic recovery it became necessary to largely increase the output of products while operating with a very limited production capacity. This could only be achieved by specialization of production and unification of products and their components.

In 1946-1951 for the first time in the USSR a unified standardized-design series of asynchronous electric motors A and AO was developed and introduced. This innovation reduced the number of types and models of engines in the power range from 0.6 to 100 kW from 179 to 14 and helped organize their assembly line manufacturing.

The time between 1955 and 1980 witnessed a further growth of the scientific and technological quality of electrical engineering products and an expansion of their nomenclature. New standardized series of products had to be developed at that time, including large electrical machines, turbogenerators, transformers and high-voltage equipment for voltages up to 1150 kV.

As the nomenclature of products and the output grew, the volume of information used in the design of new products and unification and technological preparation of production expanded. Object-based classifications could no longer support a systematic arrangement and unambiguous understanding of information, making it necessary to compile a classifier of products and components. In the 1960's the industry developed a complex of industry-wide normative documents, which helped standardize the blueprints and technical documents and select design parameters and industrial processes in a correct fashion. This complex included the industry-wide Classifier of Electrical Engineering Products, Their Components and Basic Production Documents (OAA.000.001-63), which promoted the introduction of a classificational system of codes in the industry. According to this system, the codes of products remained constant and were not to be changed when the design documents were passed along to different enterprises. The industry-wide classification system was used for code notations of products and documents, both for batch production (electrical motors, conductors, magnetic starters, etc.) and for single-item manufacturing (hydrogenerators, large electric furnaces, etc.).

As design documents for products and components were passed on from the designer to the various manufacturers, their duplicating enterprises and to the consumers, and as it became necessary to use mathematical methods and computer technology for information processing in product design and production management, the expanded interindustry contacts called for more specific rules of presentation, notation, storage, recordkeeping and circulation of design documents on a national scale.

The motive factors for introduction and general use of a classificational system of codes in electrical engineering were the expanding scale of production and requirements for organization of design and production preparation activities. The need for the switchover to the classificational system was confirmed by the industry's practical experience.

Similar processes were observed in other industries, making it necessary to develop a general national system.

All engineering industries contributed actively to the creation of the Unified System of Design Documentation [ESKD]. Since the time that the ESKD project was launched (1965), the enterprises in the industry were motivated to establish a classificational system of codes for main and secondary products.

In conjunction with the work on ESKD Classifier it became possible to introduce in 1980 GOST 2.201-80, which provided an organizational basis for a unified generic classificational system of codes of products and design documents.

The ESKD Classifier was created on the basis of several documents tested in practice; these included the following:

the Decimal Classification and Coding System for Industrial and Agricultural Products (approved by Gossplan [USSR State Planning Committee] in 1963), which was the first concept of a national decimal product classification system developed in the USSR;

industry-wide classifiers; and

the National Classifier of Industrial and Agricultural Products [OKP].

The expectation that OKP would function as a unified classification of products that could be used both in planning and management and in production has not been borne out. Attempts at introducing OKP revealed that it could not be utilized in the areas of design and technological preparation of production because of certain features of OKP associated with the organization of classes by industry and the characteristics of division that reflected the existing economic planning and management practices.

Before the decision was made to take part in the development of the ESKD Classifier, experts in the electrical engineering industry studied the possibility of retaining the existing industry-wide classifier

OAA.000.001-63. The study showed that in its contents and attributes this classifier failed to meet the present-day needs:

classes 1-3, "Products and Equipment Units," do not contain classifications for a number of products and provide a coding capacity sufficiently merely for a registry of products. For example, there is no classification for batteries, physical current sources and products of medical technology; only one code is assigned for the entire group of phase shifters, synchro-resolvers, etc. The reserve coding capacity in classes 1-3 for new products with modifications is just 1 percent;

the classification capacity of reserve classes 4, 7 and 9 is used to duplicate the groupings of classes 1-3, whose registration capacity has been exhausted, and also to classify manufacturing equipment;

the industry-wide classifier used some obsolete terms (impedancy [impedances], glukhari [log screws], pribory upryazhnye [draw gears] and others);

class names "Products and Installations" and "Assemblies and Groups" did not comply with the requirements of GOST 2.101-68; and

the functional classification characteristic of components interfered with the unification effort. For example, in order to encode a component named "Bus" the industry-wide classifier included an additional 14 varieties, meaning that up to 14,000 blueprints with the name "Bus" could be handled at an enterprise. The situation was similar with "Plates and Sheets" and "Metal Panels." With this huge number of components of a similar function, finding previously developed components and standardizing them was practically impossible.

The conclusion was that the flaws of the industry-wide classifer can only be surmounted if it is fully reworked, i.e., a new classifier had to be developed. The ministry decided to take part in the development and introduction of a Nationwide ESKD Classifier.

The enterprises in the industry have accumulated some experience in the course of introduction of ESKD Classifier into practice:

since the introduction of ESKD Classifier (1981) more than 25,000 centralized codes have been assigned to main products. This made it possible to use the new codes and specifications and also to use these codes in the identification of the main sets of documents (SB, GCh, PM [not further identified] and others);

codes at enterprises are assigned "without breakdowns," although the labor cost involved has been declining too slowly because the component classification principles are new and there is a scarcity of illustrative materials;

for most components it does not take more than 0.5 to 5 min currently to determine their characteristics. Specialists at enterprises believe that with further use of ESKD Classifier the time of searching for classification characteristics will be reduced; and

an enterprise which has recoded 97 percent of design documents has reported that the classifier covers sufficiently all varieties of assembly units and components and is suitable for convenient coding of design documents.

The recoding of the design documents is conducted according to schedules approved by enterprise managers. This allows each enterprise to plan reasonable volumes and sequences of work, so that the labor and financial cost of the operation stays within the real workloads and possibilities of their staff. In order to reduce the cost of recoding, the existing codes are taken in parentheses and the ESKD Classifier code is inscribed above the old code in the respective columns. As a result, during the transitional period the document can be registered according to two codes and ESKD Classifier codes can gradually be posted in documents which contain references to the recoded documents.

With the general participation of specialists from NII [scientific research institutes], KB [design offices] and factories, substantial work has been accomplished in the development and introduction of the ESKD Classifier. The experience with the introduction of ESKD Classifier does not vindicate the apprehensions of some experts, including the authors of [3], who argued that it is impossible to recode widely used products, that the labor cost of information processing will be increased and that the codes cannot be memorized.

We would like to discuss some of the postulates of [3] which lead to the false conclusions.

The authors of [3], for example, mention among the shortages of the coding system according to GOST 2.201-80 the large number of digits in the codes that would prevent personnel from remembering them.

First of all, a modern industry cannot rely on human memory.

Secondly, we should examine the code structure established by GOST 2.201-80 and compare it in the number of digits with the structure of codes currently in effect in the industry. The basic format established by GOST 2.201-80 consists of 13 digits, four of which are alphabetical codes of the designer organization. For each organization it is constant. In certain instances it is more efficient to make use of separate additional codes, for example, to designate standardized items (components or assembly units), auxiliary products, documents of products shipped abroad, etc. Reducing the number of digits in a code of the designer organization can deprive the enterprises in the industry of the advantages provided by the supplementary codes.

If the location of the designer organization code is varied and the number of the digits assigned to it is reduced (such as after the first digit of the classification characteristic, after the second digit, etc.), a multitude of code structures would be created, whereas a standard format makes it possible for trainees to learn the coding system.

We do not believe that the number of digits for the designer organization code established by GOST 2.201-80 should be relinquished.

The six-digit classification characteristics established by GOST 2.201-80 as the optimal length has been confirmed by theoretical classification studies [4] and the practical use of OKP in a computerized system of planning estimates [5].

In this context, the codes of design documents used in the industry can be compared in terms of the number of digits. For example, load handling devices are manufactured from blueprints with the following codes:

2566Ya.000 (8 digits)
Box handling device.
Designer: Berdyansk Experimental Factory of Lifting and Transportation Equipment.

71.005.000.000 (11 digits)
Load handling device for production containers.
Designer: VPTIelektro [All-Union Design and Development Institute of Industrial Processes for Electrical Engineering].

977.59.2.00.0.00 (11 digits)
Vacuum handling device for sheet materials.
Designer: VPTItyazhmash [All-Union Design and Technological Institute of Heavy Engineering].

The practice of the use of these codes (8-11 digits) without the designer organization code suggests that even when 11-digit codes are used it does not interfere with smooth operation or disrupt management and production processes.

The suggestion that the data concerning the group of materials should be included into the code of a component as part of the initial information for "addressing requests from the industry to the personnel responsible for the supply of materials" [3] in the materials supply services will not provide complete information even for classification groups, because in this way it is impossible to include materials for assembly and installation of products indicated in "materials" specifications. On the other hand, the classification group, while providing a general orientation for material, would not give information about the grade, sort and supply document of materials specified in the main legend of the blueprint of the component and the respective section of the specifications. The support supply services are impossible without this information. This makes it doubtful that the code of materials should be included in the designations of components.

In addition, if the code of a group of materials is included in the designation of component a new blueprint will have to be made when, for example, in order to save rolled ferrous metals they are replaced by plastics or composite materials. In this case it will be impossible to publish group blueprints.

Studies show that the feature "materials group" is not a stable one for design classification or an essential characteristic of a set of components.

Some experts believe that the main merit of an object-based system of coding is that it tells the personnel "where a component belongs." However, if 25 or 30 years ago some industries, including electrical engineering, switched from object-based to generic classification and had been using the latter to code assembly-line, batch and single-item products, thus losing this advantage, this would have meant that this loss was offset by more important convenience for the industry: the possibility of borrowing existing documents, transfer documentation without changing the formats, and standardization and definition of specializations of production. With the classificational system of codes, "where the components belong" was identified by documents included in the blueprint set and currently in ESKD.

Under GOST 2.108-68 the specification should "define the composition of an assembly unit, a complex or a set, and is necessary for preparing and putting together design documents and planning the introduction of the product." The computerization of planning can relieve the personnel of memorizing product codes. The method for evaluating the applicability of components and assembly units on the basis of specification data has been defined by GOST 3.1301-74.

The advantages of the classification system for coding products and design documents have been confirmed by years of experience in various industries, and the Unified System of Design Documentation has drawn from the experience of such applications by all organizations that issue design documents.

The current course toward a drastic improvement of technological level and product quality, increasing by several times the pace of renovation of the nomenclature of main products, faster development of new generations of new machines and equipment and the introduction of narrowly specialized plants to manufacture parts, components, assemblies and semifinished products for interindustry exchange and industry-wide use makes it imperative to rebuild the entire system of production. In this situation the introduction of a unified generic system of product and design document codes will help to develop new products faster and introduce them more rapidly into production.

The use of previously designed components and assembly units in new products, helped by the classificational system of codes, will make it possible to manufacture the components and assembly units in larger batches and thus reduce the cost of producing them.

The experience of Kriogenmash [Cryogenic Equipment Factory] shows, for example, that up to 80 percent of mass-produced components and assemblies can be used in the development of any types of new technology.

The transfer of design documentation among enterprises is becoming a normal procedure in design and production management in connection with the creation of all-union research and production associations and inter-industry scientific and technical complexes [MNTK].

The enterprises of Minelektrotekhprom [Ministry of Electrical Engineering Industry] currently take part in 10 MNTK. The design documentation of products for large-scale production developed by MNTK are to be made available to manufacturing enterprises in various industries. In these conditions MNTK cannot code documents according to systems used by the different ministries. Yet, if the manufacturing enterprise employs a different system for documentation coding a recoding is required, for which purpose special personnel are needed.

This means that both the originator of the design documentation (MNTK) and the manufacturer of products on the basis of this documentation will benefit from having a unified system of product codes.

We believe that it will be a feature of the future development of industry in the USSR that specialization and interindustry cooperation within territorial regions will be rapidly developed, as has been rightly suggested by a number of specialists in Moscow [7, 8].

The development of regional specialization will require identifying the products and primarily components used within industry and on an interindustry basis, where common principles of manufacturing and optimization of nomenclature are necessary, which is impossible without a unified classification.

Efficient use of modern technology (machine tools with ChPU [programmed numeric control] and machining centers, etc.) cannot be achieved without a stable workload throughout the entire service life of this technology (with 2.5 shifts and more). This capacity utilization within an enterprise is a difficult and for most organizations unfeasible task without additional workloads "from outside." Here, too, it is necessary to promote and develop interindustry contacts primarily within territorial regions.

Interindustry territorial contacts will never become widespread unless unified documentation codes are used.

All this shows that the transition to a unified system of codes at all enterprises of regions and, eventually, the entire country is inevitable, and the costs of the introduction of the system will be less the earlier it takes place.

In estimating the gains and losses from the introduction of ESKD Classifier we should consider that with a unified system of codes it will be possible to teach all workers, engineers and technicians to learn this system in the course of training (at PTU [vocational-technical schools], junior technical colleges and colleges), reducing the time of adaptation at the enterprises and KB.

Concerning the classification of components, the following should be noted. Published reports on the use of flexible production systems [GPS] mention an important problem--the difficulty of selecting a family of components and the related low plant capacity utilization. The experience of foreign firms with GPS shows that in modern industrial environments, where a firm should respond to changing market demand rapidly to remain competitive, the approach to classification of components has been changed in principle. The traditional classifications based on functions of components has been replaced by classification according to geometrical shape and size characteristics [9, 10]. The method of selection of component families with the use of a classifier constructed according to "morphological-dimensional" features reduces the number of components used, while retaining all of their functions and increasing the size of production batches with an optimal workload of GPS.

The classes of components in ESKD Classifier (where the main feature is the geometric shape) provide a capability for grouping components according to design features. The use of these classes in the codes of components is therefore necessary for analyzing each newly planned component to see whether an existing component could be used instead of it, which creates conditions for larger production batches.

The use of component classes of ESKD Classifier combined with an industrial process classifier makes it possible to group components according to design and manufacturing similarities, so that they can be produced with up-to-date industrial processes and modern equipment.

We do not think that the views of the authors of publication [3] are fully justified and consistent.

We object to the authors' suggestion that a new classifier should be developed. Experience shows that the creation and introduction of classifiers is a long process and that improvements are possible only the basis of practical use.

The work already done in the industry and the material and labor resources that have been invested in the introduction of a unified system of codes for products and design documents and ESKD Classifier on the one hand and the flaws of the previously used system of codes on the other rule out either a return to the old system or the need for developing any new classifier instead of ESKD Classifier.

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AUTOMATION OF A SYSTEM OF GOVERNMENT TESTING

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[Article by V.I. Shevchenko, chief of VGITs [All-Union Government Testing Center] of NPO [Research and Production Association] Mayak: "Automation of a System of Government Testing," published under the rubric "Quality Assessment and Certification: Government Product Testing"]

[Text] The functions of the principal organization responsible for government tests of magnetic recording equipment [AMZ] has been made the responsibility of the All-Union Government Testing Center [VGITs] of the Kiev Research and Production Association Mayak. After discussing the status of VGITs and the conditions in which it can operate efficiently, the staff of the center came to the conclusion that it would be impossible to fulfill the requirements for higher productivity of work by merely "adding" the new functions to the traditional organizational structures of the testing units and merely improving the isolated aspects of the operation. It was also determined that if assembly-line products are tested merely for compliance with existing specifications and standards the desirable results would not be achieved within a short time. It was decided, therefore, that the quality of newly developed products will be evaluated by government acceptance testing of prototypes according to the center's own programs and methods, while the quality of assembly-line products will be assessed during annual inspections with analysis of the results of all tests and the efforts for quality and reliability improvement by the enterprise during the preceding year. There were plans to work in close cooperation with regional agencies of Gosstandart.

The first steps taken by the center in discharging its function as the leading organization on government tests showed that information support to quality control is impossible without computers and new methods of mathematical processing of test results, with the creation of a national data bank on the quality of AMZ types and principal accessories manufactured in the USSR. Accordingly, a plan of VGITs operation was drafted that would enable the center throughout the life cycle of a product to trace the dynamics of improvement of the technological standards and quality of AMZ.

It should be pointed out that currently all ministries and enterprises are working on steps to improve the technological standards and quality of products. This raises questions that are difficult to answer: What is the informational foundation of these activities and how many of them must be performed during the life cycle of a product? Experience shows that usually far more are planned than is required for effective management. Typically, most of the activities are not fulfilled and are transferred from one plan to the next. This occurs because when stock is taken of the performance of an enterprise or an administrative agency these activities are not regarded as being of critical importance and are not included in evaluations of the performance of departments, enterprises and the industry as a whole.

While acknowledging the importance of work toward product quality improvement done by enterprises and ministries, one should emphasize the urgent need to create interindustry automated systems of government product testing and to build on this basis a data bank which is crucial for effective management of the technological standards and quality of products. When it becomes possible to utilize the comprehensive objective and reliable information, the efforts toward improvement of product quality and technical standards could be optimized and it will also become possible to prevent situations when some negative aspects in the work of enterprises are hushed up to favor narrow agency interests, while isolated achievements not strictly confirmed by objective and reliable tests are touted unjustifiably. This can be illustrated by the following examples.

After accumulating, over several years, data on the technological standards and quality of magnetic tapes and tape cassettes, i.e., after creating the data bank, VGITs of NPO Mayak offered to Gosstandart to prepare an analysis of the quality of these products. The analysis demonstrated reliably and objectively that the quality control activities that had been prepared and approved from year to year by enterprises and organizations of Minkhimprom [Ministry of the Chemical Industry] were inconsistent and ineffective. A similar picture was observed at enterprises of Minelektronprom [Ministry of the Electronics Industry]. In particular, ministry executives, transported into a state of "informational bliss" induced by reports from their subordinate enterprises, insisted on ignoring consumer complaints about the poor quality of certain types of connectors and microcircuits. It was only the comprehensive tests conducted jointly by VGITs of NPO Mayak and UkrTsSM [not further identified] that yielded reliable information confirming the poor quality of these products.

This example is further evidence that creating a data bank on product quality and technological standards is an urgent need confirmed by experience.

What is being done to further this objective by VGITs of NPO Mayak?

Until recently, the experimental methods of tests were far ahead of theoretical analysis in view of the specifics of magnetic recording. In absence of a strict mathematical theory of AMZ tests, simplified methods were used which failed to produce the necessary information with guaranteed accuracy, reproducibility and reliability [1]. As a confirmation, this can be illustrated by the simulation of test conditions for automobile AMZ according to GOST 11478-75.

Bench test conditions according to these standards were so unrepresentative of real conditions of operation as far as mechanical stresses are concerned that this type of test had to be abandoned. Field (range) tests were not called for by the standard. Road (driving) tests performed on rare occasions according to some special methods were of a passive type with low informativity and practically no reproducibility. Mostly conventional methods of quality assessment were used based on parameters measured in laboratory (easy) conditions. The errors of design and other design flaws were not revealed in time. As a result, the introduction of new products into manufacturing required more time, the number of complaints increased and the loss from scrapped products was growing. It is not surprising that factories were reluctant to introduce large-scale manufacturing of this relatively new type of AMZ.

In view of the goal that was the set, the existing methods of automobile AMZ testing were recognized as unacceptable. In conformity with the program of comprehensive standardization for the 11th Five-Year-Plan period, VGITs of NPO Mayak with assistance from Gosstandart institutes created a basically new methodology of government testing of automobile AMZ which included the use of computer technology.

Since probabilistic methods of prediction of causes and factors reducing product quality have not been used in practice of testing of electronic equipment, we decided to employ the theory of mathematical planning of active experimentation, which makes it possible to incorporate into tests real operation conditions [2, 3]. In particular, for the first time in Soviet practice we measured the effect of car driving on the tape drive of the tape recorder as the most vulnerable element in terms of vibration stability. In addition, a series of pulse-measuring, force-measuring and service cassettes KM-1, KM-2, KM-3, SK-1 and KSL-1 were prepared, since the previous indirect methods of adjustment and monitoring of tape drives were cumbersome and utterly unsuitable for measuring the forces in assembled tape recorders, especially in field conditions [4].

After a mobile measurement complex was created by VGITs of NPO Mayak (see fig. 1) and the appropriate mathematical models (footnote) ($K_{ma} = \phi(v,Q,q)$; $K_d = (v,Q,q)$; $M_i = \phi(v,Q,q)$, where K_d is the detonation coefficient; K_{ma} is the coefficient of spurious modulation amplitude; M_i is the mode of the spectral density of vibration; v is the automobile speed; Q is the automobile load; and q is the height of microscopic unevenness units of the coating) were developed, it became possible to perform government testing of AMZ in real operation conditions and process the resulting data on a computer. On the basis of field tests, mathematical models were devised which can predict the behavior of AMZ in a "road-automobile" system.

The experience with the development of mathematical models for automobile AMZ testing and the use of matrix methods for computer analysis of nonlinear processes with many unknowns made it possible to create a computerized system of government testing [ASGI] of all kinds of magnetic recording equipment (stationary, portable, hand-held and combination types).

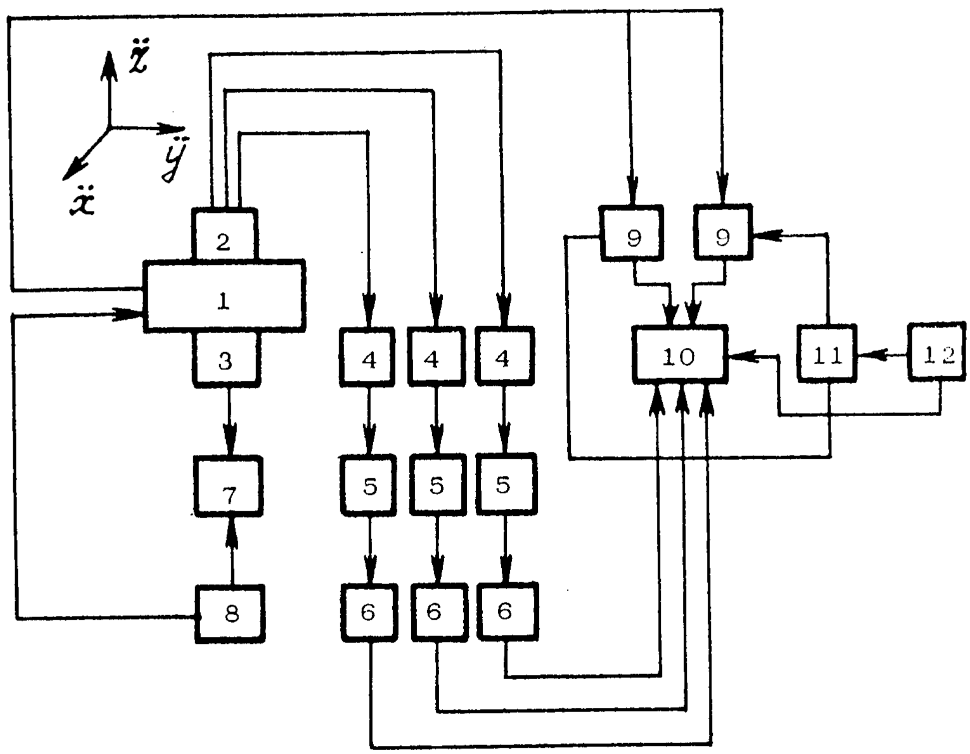

Figure 1. Flowchart of mobile measurement complex: (1) AMZ; (2) three-component accelerometer; (3) dispersiometer sensor; (4) input adapter; (5) integrator; (6) noise measurer; (7) dispersiometer; (8) power supply network; (9) detonometer; (10) magnetograph; (11) transducer; (12) additional power source.

ASGI will, first, improve testing productivity and reduce testing time; second, accelerate the introduction of advanced technology and reduce the time and cost of new research by utilizing the bank of data on the quality of earlier products; and, third, solve problems that defy analysis with conventional testing methods. In order for ASGI to become a catalyst of technological progress in this field of technology, a number of important problems will have to be solved. This will include, in particular, revisions of the existing system of standards for selection and official establishment of informative parameters of products, changes of the existing methods of tests and measurements so as to improve objectiveness, reliability, precision and reproducibility, unification and standardization of the methods of processing accuracy evaluation and representation of testing results, and unification of technical, methodological, metrological, programming, and informational and organizational support of tests.

The creation of ASGI at GITs [government testing centers] in various fields of technology will make it possible to certify products for domestic and foreign markets at the up-to-date technological level; to supply timely and reliable information on product quality to all management levels and to concerned consumers; to raise the objectiveness, precision and reliability of government tests; and to reduce testing time.

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BOOK: INFORMATICS AND DESIGN

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[Text] Contents

ANNOTATION

The brochure is devoted to one of the new directions applying mathematical methods and computer technology to solve the problem of designing complex systems and projects. It discusses fundamental methodological principles in the construction of an automatic design system and the role of informatics in creating the basics of the theory of designing complex engineering projects. It is made for lecturers, auditors and teachers in the national universities.

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DIALOGUE PROCEDURE FOR FORMATION OF ORDINAL MEASUREMENT SCALE

Tbilisi SOOBSHCHENIYA AKADEMII NAUK GRUZINSKOY SSR in Russian Vol 123, No 1, 1986 (manuscript received 22 Jun 84) pp 53-56

[Article by T. F. Kikvadze, Institute of Control of the Economy, State Commission on Science and Technology, Georgian SSR]

[Abstract] A dialogue procedure is suggested for constructing an ordered scale of measurements, assuming that a subject expert can give preference or declare equality of any two objects from a set of objects which must be placed in the scale. The results of each paired comparison are recorded in a table as an arbitrary object from the set is compared to all others, yielding three nonintersecting sets consisting of those objects ranked higher, lower and equal to the selected object. The procedure is repeated until the entire set of objects can be placed in order. References 3: Russian.

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UDC 681.324

DETERMINING DEFECTS AND FUNCTIONAL INCOMPATIBILITY OF COMPONENTS OF AN INFORMATION NETWORK ELEMENT

Tbilisi SOOBSHCHENIYA AKADEMII NAUK GRUZINSKOY SSR in Russian Vol 124, No 2, 1986 (manuscript received 28 Feb 85) pp 281-284

[Article by Kh. V. Lekiashvili, Institute of Control of the Economy, State Commission on Science and Technology, Georgian SSR]

[Abstract] The functioning of an information network element is studied. A method is suggested for location of defects and determination of functional incompatibility by analyzing the technical, operational, informational and algorithmic aspects of operation of the element. Methods are listed for forming a list of the activity and control functions disrupted due to defects in individual replaceable elements. Reference 1: Russian.

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A DIALOGUE ACROSS CONTINENTS

Moscow EKONOMICHESKAYA GAZETA in Russian No. 13, Mar 87 p 9

[Text of article entitled A Dialogue Across Continents, author unknown]

[TEXT] In order to create new techniques and technology at the level of the best world standards, it is necessary to have information about what is being done in this field in various countries of the world. Information about the leading scientific-technical solutions must be not only complete, but quite current as well.

Here, the National Center for Automated Information Exchange With International computer Networks and Data Banks (NCAE) is called upon to play a large role. It was created based on the All-Union Scientific Research Institute for Applied Automated Systems [VNIIPAS]. This is what the director of this institute, Doctor of Technical Sciences Professor O.L. Smirnov and his deputy, Candidate of Technical Sciences Yu.A. Savostitskiy, told our correspondent.

We imagine a situation such as the following: Some scientific center found a solution to a certain problem. A short announcement is immediately composed and is sent to a scientific journal.

It is well-known that such information may appear in a current scientific publication only two or three months after the results are received. Then this publication, before going to the specialists who are working on solutions to analogous problems, must cut across the borders of governments, and undergo additional manual processing. No less than two to three weeks are spent on this. Is it possible to receive information at least 10 times faster? It is possible. A centralized system for the automated exchange of information (CSAE) has been developed for this purpose.

It began to operate in 1984 in our country in the realm of industrial utilization. There are about 3000 data banks in the world, and we can use many of them on an agreement or contractual basis. Such data banks have been created in our own country as well.

In order to utilize the information system, it is necessary to become a subscriber to the NCAE. In order to do this, those wishing to join the organization or department must apply officially to the National Center. Depending on where they are located, the subscribers are served by either the main (Moscow) or regional centers in Leningrad, Riga, Vilnius, Kiev, Sverdlovsk, Tashkent, Alma-Ata, Tbilisi, Khabarovsk and Vladivostok.

Subscribers who have the necessary equipment can establish terminal stations directly in their organizations, providing access to the VNIIPAS Telecommunications Center. And the center, in turn, organizes the outlet onto the computer-information network developing in our country - the "Akademset" network, which includes the above-mentioned domestic centers. Access onto international computer networks is also possible.

One of the additional possibilities of the CSAE is that one can instantly transmit reports from user to user. In this case, the system works in an electronic mail mode. The CSAE Telecommunications Center is like a "round table," at which Soviet and Foreign representatives can meet and discuss problems that interest them.

Teleconferences - direct dialogs between the subscribers of the NCAE - are already taking place. This new information technology is transforming from a novelty into an everyday instrument of scientific and administrative activities. What does the application of this technology yield in practice? For example, in the course of this five-year-plan, an increase in the share of domestic machine construction in the total volume of exports and a simultaneous increase in the effectiveness of the technology purchased from abroad are planned. It is therefore important to study the international marketplace, in order to more precisely calculate foreign-market prices, correctly select contractor firms, and to fathom the world level of production quality. In other words, to skillfully conduct economic market conditions analysis. The workers of our foreign-trade associations are utilizing more and more the possibilities of the statistical information capabilities of such analysis. In fact, information that has come through the NCAE has been utilized for solving one of the problems of the Gosagroprom of the USSR. There, for the special complex program, formulated for the Twelfth Five-year-plan, an analysis of all technical means that are applied in automated control systems by industrial pig-breeding complexes was conducted. As a result, it turned out that, with the help of information received through CSAE, it is possible to save 400 thousand rubles in the acquisition of equipment for each feeder having 200 thousand animals. In addition, precise information allows rapid evaluation of different methodologies for animal husbandry, selection and feeding, and makes analysis of the work and state of affairs in leading foreign firms, and comparison of the potential of domestic developments with their foreign analogues possible.

In this five-year-plan the development of CSAE is taking place in several directions. The most important of them is the joint development by the member-nations of the Council for Mutual Economic Assistance of high-speed microprocessors, which facilitate high-speed systems for automated information exchange between them.

Another joint project consists of the creation of a number of program packages. One of them is necessary of the education and training of the users, others perform part of the intellectual functions that occur in the interaction of the user and the computer. This in particular allows leaders at various levels of user organizations to obtain not simply a set of data, but information processed in the manner and to the degree that is necessary for each case.

This is a task for the future. And in principle, the day is no longer very far away when each production organizer, economist, and scientific-technical worker will receive all the information he needs directly from the control panels of his terminal or personal computers.

13151
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RECURRENT IDENTIFICATION OF NONLINEAR OBJECTS OF HAMMERSTEIN CLASS

Tbilisi SOOBSHCHENIYA AKADEMII NAUK GRUZINSKOY SSR in Russian Vol 123, No 1, 1986 (manuscript received 6 Sep 84) pp 57-60

[Article by F. F. Pashenko, G. R. Bolkvadze and M. V. Belkina, Institute of Cybernetics, Georgian Academy of Sciences; Institute of Control Problems, USSR Academy of Sciences]

[Abstract] This article studies problems of recurrent identification of nonlinear Hammerstein class dynamic objects using for identification an algorithm which is optimal in the class of single-step algorithms. The algorithm generated is superior to previous algorithms both in rate of convergence and in accuracy of approximation. References 4: Russian.

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UDC 518.12

ONE ALGORITHM FOR SEARCH FOR A GLOBAL EXTREME

Tbilisi SOOBSHCHENIYA AKADEMII NAUK GRUZINSKOY SSR in Russian Vol 124, No 2, 1986 (manuscript received 21 Dec 84) pp 285-288

[Article by A. I. Kuznetsov, "Granit" Production Association, Moscow]

[Abstract] Two classification procedures are analyzed, overcoming the difficulty encountered in determining a global extreme in the case when global and local extremes are similar in value of goal function but remote from each other in the space of parameters. A combined optimization algorithm is described in which information obtained in the process of a search is used to draw a conclusion as to whether the goal function has multiple extremes, and an estimate of the number of extremes is computed. The solution of the multi-extreme problem is reduced to determination of areas of influence of local extremes with subsequent selection of the best area. Use of a cluster analysis procedure significantly expands the class of goal functions for which the method of Ψ transforms can be applied. References 5: Russian.

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UDC 65.330.115

EXISTENCE OF THE UNIFORM SUBDIVISION IN CLASSIFICATION MODELS

Dushanbe DOKLADY AKADEMII NAUK TADZHIKSKOY SSR in Russian Vol 29, No 4, 1986 (manuscript received 9 Dec 85) pp 197-200

[Article by M. Saidov, Tadzhik Affiliate, All-Union Scientific Research Institute of Problems of Organization and Control; USSR State Committee on Science and Technology]

[Abstract] A study is made of the principle of producing a uniform subdivision, necessary to solve a number of applied problems related to the formation or improvement of control structures. The model generated was used to solve a broad range of problems relating to optimization of organizational management structures. References 5: Russian.

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UDC 519.95

DECOMPOSITION CONTROLLABILITY OF A ROBOTIC SYSTEM

Baku AKADEMIYA NAUK AZERBAYDZHANSKOY SSR in Russian Vol 41, No 12, 1986 (manuscript received 12 Dec 83) pp 10-13

[Article by O. K. Khanmamedov, Institute of Cybernetics, Azerb Academy of Sciences]

[Abstract] A previous study analyzed the problem of controllability of a robotic system described by a homogeneous difference equation. Results on full and weak controllability were presented relating to the case of a strongly connected control graph. In this article these results are extended to the case of a robotic system with a control graph of arbitrary form. The results presented in the article show that, regardless of the specific values of controlling actions, the behavior of a robot is controllable in either a half group or half ring of operators. This leads to the important conclusion of technical possibility of implementation of a control device for an adaptive or smart robot in the class of specialized microprocessor devices which do not use computers but allow control of a robot in real time. References 4: Russian.

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UDC 578.087.1

MODELING OF PERIODICALLY CHANGING BIOLOGICAL POPULATIONS

Tashkent IZVESTIYA AKADEMII NAUK UzSSR. SERIYA TEKHNICHESKIKH NAUK in Russian, No 5, 1986 (manuscript received 23 Sep 85) pp 3-7

[Article by A. Makhmudov, Uzbek "Kibernetika" Scientific-Production Association, Uzbek Academy of Sciences]

[Abstract] Equations are derived which generate a model of the growth of biological populations in which enumeration by ages is not included. Equations are derived for the age structure of the group and a methodology is constructed for further development of Fibonacci models. A method is noted for complicating the model, based on food-resource limitation, by addition of new limitations considering various external influences on the population. References 5: Russian.

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COMPUTER TRAINING FOR STUDENTS

Moscow VECHERNYAYA MOSKVA 12 Feb 87 p 1

[Article by A. Presnyakov: "First Time at the Computer"]

[Text] The faces of the beginners who are sitting at the desks of the computer consoles are concentrated.

Attentively following the running lines of words and numbers on the illuminated display screen they become acquainted with computer language. In a classroom of the Computer Science Department of the Polytechnic Museum regular lessons began today.

Let's visit the equipment in the auditorium. Along the edges of a long table are placed twenty interactive computers. The console of the instructor allows him to supervise the activities of each trainee. The educational process is conducted with three programs.

The first is intended for the students of the eighth and ninth grades and includes getting acquainted with the keyboard and function of the computer. The second version is for students of the ninth and tenth grades. They become acquainted with the basics of composing algorithms. And finally the third level of instruction is work on the interactive computer complex.

Students from the middle schools, PTU and even correspondence course students will study in the auditorium of the museum.

13093
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DISCUSSION OF MAGNETIC TAPE PRODUCTION PROBLEMS

Moscow LITERATURNAYA GAZETA in Russian 11 Feb 87 p 10

[Article by S. Vonsovskiy, academician, chairman of the Science Council of the USSR Academy of Sciences: "The 'Magnetic Storm' Has Not Subsided"; first two paragraphs are source introduction]

"Our lagging behind in production of magnetic tape is inexcusable. It is a high volume carrier of information, the bread of progress, a thousand times more important than paper, which we even now consider the bread of culture," wrote engineer Ye. Nedzvetskiy, opening a collection of materials, "In the Epicenter of the 'Magnetic Storm'" -- about the reasons for the inferior quality of tape for sound recording (LITERATURNAYA GAZETA Feb. 19, 1986). The chief engineer from "Soyuzkhimfoto", candidate of technical sciences A. Nilov, head of the laboratory of the Ministry of Electronics Industry G. Glebov, and assistant head of the main office of the Ministry of Communications Equipment Industry Ye. Kovalenko took part in a discussion of the problem. Today we are publishing the response of academician S.V. Vonsovskiy.

The problem brought up for discussion by the newspaper is very real, its solution has really been delayed, and this hinders the development of scientific and technical progress in many parts of the national economy of our country.

Although, in my opinion, in the scientific aspect not all is in order here -- our physical experimental research in this field has lagged behind in comparison with foreign countries --such as the USA, Japan, and several others. "The attacking side" in this particular micro-debate conducted by the LITERATURNAYA GAZETA" absolutely correctly points out the root of the evil. It is unnecessary monopolization. Responsibility for ensuring, for example, with magnetic tapes the needs of the government is concentrated in the hands of one highly-profiled department. Completely absent is objective, competent control of the basic parameters, which determine the technical characteristics of the products, so that it is not possible to guarantee their stable operational reliability.

Progress in creating and utilizing magnetic tapes even depends on how high the quality of their manufacture is. And the development of specific instruments for control and certifi-cation becomes an integral component in solving the general problem. This matter already no longer concerns only chemical fields. It is necessary to agree with the proposal of the need to create an interdepartmental science and technology center.

Of course, this center will be active in scientific maintenance, but at first it is necessary to consider its main task, namely engineering and technological problems, and it should be given the status of an interdepartmental engineering center with a prevailing integrated function. The basic organizational form for the work of such a center should be an interdepartmental integrated system program. On its basis it will coordinate the activities of industrial enterprises of various branches and the expert approval of science and tech-nology developments from the academic and industrial NII (scientific research institute) and VUZes.

Economic planning and administrative control by the enterprises -- executors of the integrated system program -- must transfer to this center. Such a program in its turn should become an element of the state plan for these enterprises, independent of their departmental affiliations. Obviously, the organization of such an engineering center ought to be carried out under the aegis of the GKNT and the presidium of the USSR Academy of Sciences. As head may become one of the most prominent industrial NII of the radioelectronic section. It is necessary to attract to the organization of the center also the scientific advise of the USSR Academy of Science on the problem of "the physics of magnetic phenomena" and even Gosstandart and the State Committee for Inventions.

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